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Preferential Trade Agreements, taxation, and industry location

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Preferential Trade Agreements, Taxation, and Industry Location

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Notwithstanding all of the above support for this thesis, any errors and/or omissions are solely my own.

Declaration

I declare that I am the author of this thesis and that I have consulted all the references cited. All the work of which this thesis is a record has been done by myself and has not been previously accepted for a higher degree.

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Date .....

Certification

I certify that Mr. Chaiyasith Boonyanate conducted his research under my supervision in the Department of Economic Studies, University of Dundee. Mr. Boonyanate has fulfilled all the conditions of the relevant Ordinances and Regulations of the University of Dundee for obtaining the Degree of Doctor of Philosophy.

Catia Montagna

Professor of Economics

Date .....

Abstract

Preferential Trade Agreements (PTAs) affect both the pattern of trade and the location choices of Foreign Direct Investment (FDI). Thus, the formation of a PTA may have adverse effects on the excluded countries and result in inter-regional tax competition. Nonetheless, this connection has not so far been fully analysed in the literature. This thesis is an attempt to fill in this gap in the theoretical literature by examining the effects of the formation of a PTA on the location of industry and welfare of the countries involved, as well as investigating the impact of subsequent policy responses that may arise as a result of the adverse effects of the formation of a PTA.

We motivate our theoretical analysis we first conduct a preliminary empirical study to investigate whether a recent decline in the statutory rates of corporation income tax (CIT) is caused by tax policy interactions among countries. To do so, we use data for 21 EU countries from 2000 to 2009 to carry out an econometric analysis of tax policy interactions among EU countries. Our results support the hypothesis that some European countries' governments used statutory CIT rates to compete against other countries. We also find that, at the individual country level, the high personal income tax rate countries use the effective marginal tax rate while the lower personal income tax rate countries use the CIT rate to compete over attracting investment.

We then construct a three-country general equilibrium model based on the New Economic Geography approach to analyse the possible effects of the formation of a PTA as well as the effects of the subsequent policy responses. We consider the situation in which two of the countries form a PTA and the third country acts as the 'rest of the world'. The simulation results suggest that:

- An eradication of intra-tariff between PTAs member countries always attracts investments from the excluded country.
- A rise in the external tariff rate − by the excluded country – is not an effective policy to retain investments, where firms already agglomerate in PTA area.
- The excluded country's government has no incentive to reduce its CIT rate if the external tariffs are sufficiently high.

Our theoretical setup also enables us to show that PTA member countries may respond to the reduction of the excluded country's CIT rates. Specifically, the scenario in which only one of the member countries engages in tax competition with the excluded country, while another member keeps imposing its status quo CIT rate, the most innovative part of our contribution, can be used to explain the difference in CIT rates observed within the EU in which, in the presence of virtually free intra-EU trade, some members impose very low CIT rates and are able to attract a large portion of investments whilst other EU countries choose to maintain higher CIT rates.

Chapter 1

Introduction

1.1 Motivation

Multilateral free trade is widely considered as a first-best scenario for the global economy. However, this scenario has yet to be materialized, since successive rounds of trade liberalisation negotiations under the auspices of the GATT/WTO have been marred by disagreements. Instead, a proliferation of Preferential Trade Agreements (PTAs) has been notified to the WTO in the last couple of decades. This type of trade liberalization can be considered as a second-best scenario. Some would argue that the PTAs are compatible with the goal of multilateral trade liberalization, although others disagree. Nevertheless, the number of agreements is still increasing, as many countries are expecting to sign up to the new ones. One important reason for this to happen is that policymakers perceive that their countries can achieve their development and economic growth objectives and earn other benefits from signing up to such agreements. The hope for benefits consists in opportunity to access major markets, increasing competitiveness as well as access to foreign technologies and investment.

Not only do PTAs affect the pattern of trade but also extend to the cross border flows of capital. Such flows of capital can benefit host countries not only by providing direct capital financing but also by creating positive externalities via the transfer of foreign technology and know-how. Accordingly, there is a widespread perception among policymakers that foreign capital has positive effects in terms of productivity improvements in host countries and enhancement of economic development. However, the cross border flows of capital can possibly be either short-

term or long-term. The former is intrinsically very volatile, which may create adverse effects on the economy. Hence, policy makers generally are more interested in attracting long term cross border flows of capital − of which Foreign Direct Investment (FDI) is the most noticeable one − into their country or region. Evidently, the flows of FDI are closely associated with the location of investment and economic activities, because FDI represents the activities of firms outside their home country. Therefore, it implies a 'choice of location' – the decision about new business locations in particular (Soci, 2007). Researchers have found evidence that the formation of PTA can attract FDI into the countries in the bloc − frequently at the expense of the excluded countries. For example, MacDermott (2007) finds that NAFTA caused an increase in FDI flows into the member countries. Not only do PTAs attract investment from non-member countries, but also cause the reallocation of investment among member countries within the trading bloc. Tekin-Koru and Waldkirch (2010) find that NAFTA member countries' FDI flows to Mexico was positively affected by the formation of NAFTA. Analyzing the role of the Europe Agreements on bilateral FDI within Europe, Baltagi, Egger and Pfaffermayr (2008) find evidence of a relocation of inward FDI from Western European host countries to Eastern European host countries flowing from these agreements.

Given that PTAs potentially affect the location choices of FDI, policy makers may believe that they can attract new firms or prevent existing firms from leaving the country. In particular, if Preferential Trade Agreements induce either the members or the excluded countries to opt for aggressive action – particularly by using taxation policies − then they may trigger intergovernmental tax competition. Empirical evidence points to the existence of intergovernmental competition at both intra-regional and inter-regional levels. For example, Altshuler and Goodspeed (2002) find

that European countries behaved as if the US was the Stackelberg leader in setting corporate taxes after 1986, the year of major US tax reforms. Devereux, Lockwood and Redoano (2008) find evidence that an OECD country's statutory corporate income tax rate and effective marginal corporate income tax rate were positively affected by that of its competitors during the 1988- 1999 period. Overesch and Rincke (2011), who focus on explaining the recent decline of corporate tax rates in Europe, find that statutory corporate income tax rate strongly react to competition during the 1983-2006 period. Recent policy changes in many countries resulted in an intensification of global competition among governments to attract FDI. This has resulted in raising concerns among policymakers that tax competition may have undesirable effects by producing a continuous harmful increase in costly investment incentives that deteriorate countries' public finances and create market distortion in the allocation of real investment.

However, one may question the effectiveness of a government decision to engage in intergovernmental tax competition over mobile capital if such competition may be wasteful − in the sense that it may either make its citizen worse-off (even if it were successful in attracting FDI) or not be able to attract FDI at all. This may happen because taxation policies are not the only sole or even the main factor determining the location of investment. For instance, Schiff and Winters (2003, p.18) argue that the key factor driving investment is the general policy stance in areas such as sound macroeconomic policies, well-defined property rights, and efficient financial and banking sectors. Taxation policies may foster investment but only if they are accompanied by sound policies overall.

The aim of this thesis is therefore to explore:

i) The effects of the formation of Preferential Trade Agreements on the location of industry and welfare within the member countries as well as the excluded countries.

ii) The effects and consequences of the subsequent policy responses that may arise as a result of the adverse effects of the formation of a Preferential Trade Agreement. In particular, we shall focus on the modification of import tariff and corporate income taxes by governments – which may trigger international tax competition − in response to the loss of industry resulting from the formation of a Preferential Trade Agreement.

However, in order to do pursue these aims, we would need to ascertain that there are indeed strategic taxation policies' interactions on the location of industry among governments. This is because governments may also have other reasons to adjust their taxation policies rather than just engaging in tax competition. Therefore, we will conduct a preliminary empirical study to investigate whether a decline in the statutory rates of corporation tax in the EU is caused by strategic tax policy interactions among EU countries. The next step will then consist in studying the effects of the enlargement of the EU. Specifically, we shall look at whether the accession of the new member states intensifies tax competition among EU countries. To do so, we use data for 21 EU countries from 2000 to 2009. The instrumental variables and the two-stage estimation method are used to investigate strategic tax policy interactions among EU countries. Three types of weight matrixes are computed in order to provide the basis for an evaluation of the presence of strategic tax policy interactions among EU countries, i.e. (1) uniform weight; (2) distance-

based weight; and (3) competition-based weight. The empirical approach follows a similar methodology to that used in Devereux, Lockwood and Redoano (2008) and Overesch and Rincke (2011).

We then construct a theoretical model based on the New Economic Geography approach to analyse the possible effect of the formation of Preferential Trade Agreements as well as the effects of the subsequent responding policies that may arise. Taking into account that trade in goods has become more 'vertical' in nature, as intermediates account for an increasing share of total trade, the theoretical model in this thesis builds upon the Footloose Capital Vertical Linkage model (FCVL) developed by Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud (2003) and Robert-Nicoud (2006). One of the distinct features of this model is that it explicitly models firm-to-firm sales of intermediates that are used as factor inputs in the production by single-plant national firms. Thus, the model incorporates the vertical fragmentation of production into the analysis. Generally, the New Economic Geography models use an ad hoc migration equation to govern the movement of either skilled labour or capital between countries. However, we introduce a capital allocation mechanism that is underpinned by an assumption of imperfect substitutability between the capital stocks from different countries to the model instead of using such an ad hoc equation. As a result, an investor may prefer to invest in a particular country rather than in others. Specifically, the allocation of capital is characterized by a constant elasticity of transformation function (CET). Furthermore, the New Economic Geography models generally use several normalizations in order to get an analytical result, which may be problematic in some version of the model. Therefore we decide to use a numerical simulation to help us analyse the behaviour of the model instead.

Specifically, our theoretical results can be summarised as follows:

i. We find that an eradication of intra-tariff between PTAs member countries always attracts investments from the excluded country. The formation of PTAs can possibly yield three different outcomes depending on the member countries' characteristics as well as the existing external tariffs level, i.e. 1) all countries are better off, 2) only member countries are better off, and 3) all countries are worse off.

ii. We show that perfectly free trade among PTA member countries, when the total expenditures of these countries are different, would equalize rates of return for firms operating in these countries. As a result, investors are indifferent in choosing the location of their investment between the member countries. However, the preferential trade among PTA member countries which differ in the levels of total productivity would not equalize rates of return for firms operating in these countries. In spite of this, firms operating in a low productivity member country still benefits from an agreement, as it would enable them to reduce their cost of production by importing intermediate inputs from a high productivity (and low cost) member country. Consequently, rates of return from firms in a low productivity member country will increase as a result of PTA formation.

iii. We show that raising the external tariff rate − by the excluded country – is not an effective policy to retain investments, where firms already agglomerate in CU area.

iv. The excluded country's government has no incentive to reduce its corporate income tax rate, if the external tariffs are sufficiently high.

However the reduction of corporate income tax may become an effective instrument for the excluded country's government to retain investments, if the external tariffs are sufficiently low.

v. The reduction of the excluded country's corporate income tax rate − at sufficiently low level of external tariffs − may result in three possible scenarios. The first one is that member countries choose not to engage in intergovernmental tax competition. The second one is that member countries engage in intergovernmental tax competition. The last one is that only one of member countries engages in tax competition with the excluded country, while another member keep imposing its status quo corporate income tax rate.

Generally, the findings of this thesis support the propositions as well as contribute to extend the existing literature. Among our most important contribution is that we introduce an explicit capital allocation mechanism instead of using an ad hoc equation, as is usually done in the New Economic Geography literature. Another key contribution of the thesis is that our setup enables us to show that member countries may respond to the reduction of the excluded country's corporate income tax rates. Specifically, the scenario in which only one of the member countries engages in tax competition with the excluded country, while another member keeps imposing its status quo corporate income tax rate is new to the literature. This scenario goes against the results that generally emerge from the literature based on New Economic Geography as well as from basic tax competition frameworks in which the reduction of CIT rate would generate a race to the bottom in tax competition between countries under perfectly free trade. This result is important as it contributes to explain the difference in corporate income tax rates observed in the EU in which, in the presence

of virtually free intra-EU trade, some members impose very low CIT rates and are able to attract a large portion of investments whilst other EU countries choose to maintain higher CIT rates.

1.2 Outline

The rest of this thesis is organised as follows: Chapter 2 carries out a preliminary empirical study to investigate whether a decline in the statutory rates of corporation tax in the EU is caused by strategic tax policy interactions among EU countries. Furthermore, we look at whether the accession of the new member states has resulted in an intensification of tax competition among EU countries. To do so, we use data for 21 EU countries from 2000 to 2009. The instrumental variables and the two-stage estimation method are used to investigate strategic tax policy interactions among EU countries.

Chapter 3 offers a review of the literature on the theoretical studies on Preferential Trade Agreements and intergovernmental tax competition.

In Chapter 4, we develop a three-country, two goods (sectors), two primary factors computable general equilibrium model based on the Footloose Capital Vertical Linkage model (FCVL) developed by Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud (2003) and Robert-Nicoud (2006). We then carry out a comparative static analysis, which allows us to investigate the effects of the key parameters and variables on the behaviour of the model.

Chapter 5 focuses on the effects that the formation of a Preferential Trade Agreement has on the location of industry and welfare within the member countries as well as the excluded countries. To do so, we carry out simulations using the model developed in Chapter 4. We then discuss and compare simulation results with a

benchmark scenario, which is a pre-PTA formation equilibrium. We first examine the effects of two particular types of PTAs, i.e. a Customs Unions and a Free Trade Agreement, within a symmetric country framework – so as to study the effects of a PTAs strategy in the simplest environment. We then examine the effects of forming the PTA, within an asymmetric country framework in term of endowment and country's characteristics, as a tool to attract and/or retain internationally mobile firms.

Chapter 6 investigates whether the excluded country has an incentive to adjust its policies in response to the PTA formation. We then analyse the effects of the subsequent responding policies that may arise as a result of the adverse effects of the formation of Preferential Trade Agreement. Specifically, we investigate the effects of either external tariff modification or corporate income tax reduction by the excluded country with plausible responses from PTAs member countries. We again carry out simulations using the model developed in Chapter 4 and discuss and compare simulation results with a benchmark scenario, which is the PTA formation equilibrium derived in Chapter 5.

Chapter 7 concludes the thesis by providing the summary of the primary finding, some policy implications, as well as suggestions for future research.

Chapter 2

Corporate Income Taxation in the EU Countries and Competition to Attract International Investment

2.1 Introduction

In the complete absence of trade barriers, trade costs for intra-EU trade would not be significant and, as suggested by the theoretical literature on foreign direct investment, this would reduce incentives to undertake intra-regional trade-cost jumping Foreign Direct Investment (FDI). In such a situation, the location choice of investments would primarily be driven by firms' desire to either seek to operate more efficiently across inter-regional borders or to gain higher net rates of returns. This would also increase the importance to location decisions of the level of corporate income tax levied by each country, as it directly affects relative net rates of return. For this reason, policy makers and international institutions such as the OECD and the European Council are concerned that the absence of trade barriers would likely create a race-to-the-bottom in tax competition. The theoretical literature on foreign investment also suggests that the common market in the EU is also likely to attract inflows of export-substituting FDI from outsiders. Accordingly, the enlargement of the EU may additionally intensify tax competition, if new member countries compete with existing member countries for the same sources of investments. This concern is reinforced by the substantial decline in the statutory rates of corporate tax observed in the EU since the early 1980s.

One of our main objectives in this thesis is to study the effects of taxation policies on the location of industry. Before we take a step further, however, we would need to ascertain that there are indeed such taxation policies' interactions

among governments. This is necessary because governments may also have other reasons to adjust their corporate income tax policy rather than just engaging in tax competition. For example, they may need to raise revenue to finance either the demand for an increase in public spending or the demand for a reduction in public borrowing. The ideological stance of the policy authorities may also affect taxation policy. Therefore, we will conduct a preliminary empirical study to investigate whether a decline in the statutory rates of corporation tax in the EU is caused by strategic tax policy interactions among EU countries. We shall then examine the effects of the enlargement of the EU. Specifically, we shall look at whether the accession of the new member states has intensified tax competition among EU countries. In order to investigate these two issues, we will seek to answer the following two empirical questions:

1) Does the corporate tax rate of a country depend significantly on the corporate tax rates of other countries?
2) Did the accession of the new member countries in 2004 intensify the incidence of tax competition?

To do so, we use data of 21 EU countries from 2000 to 2009. We can separate these countries into two groups. The first group comprises of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherland, Portugal, Spain, Sweden and the UK, which joined the EU before 2000. The second group consists of the Czech Republic, Estonia, Hungary, Poland, the Slovak Republic and Slovenia, which joined the EU in 2004. We first regress the corporate tax rate of a country on the weighted average corporate tax rates of other countries and other control variables to answer the first empirical question. For the second empirical question, we include the additional data of the groups that join the

EU in 2004. We then regress the corporate tax rate of a country on the weighted average corporate tax rates of all other countries, the weighted average corporate tax rates of the new members and other control variables.

We find evidence that European countries' governments have used statutory corporate income tax rates as competition policy instruments against other countries. These results also complement the relevant existing literature. We also find evidence that governments may use only statutory corporate income tax rates – not effective marginal tax rates − as a backstop to the reclassification of labour income as business income.[1] Moreover, we find that the level of personal income taxes reduce the impact of international tax competition. The higher is the level of personal income taxes the lower tends to be the overall impact of inter-governmental statutory corporate income tax competition. Finally, we cannot find any evidence that the additional regressors, which capture the effect of EU enlargement in 2004, are significant. Therefore, we conclude that the enlargement of EU did not intensify tax competition among EU countries.

The chapter proceeds as follows. Section 2.2 reviews recent empirical literature. In section 2.3, we empirically investigate whether the reduction in corporate income tax rates in the EU countries can be explained by governments competing to attract freely mobile capital. Additionally, given the enlargement of the EU in 2004, we try to examine how competition features in determining the reaction of the two groups of countries which joined the EU at different times. Section 2.4 concludes the chapter.

[1] As pointed out by Gordon (1998), "when the top personal tax rates are above the corporate rate, high income individuals have an incentive to reclassify their earnings as corporate rather than personal income for tax purposes." Personal income taxes are generally levied as a percentage of a person's total wages or salaries, with some deductions permitted, while corporate income taxes are levied on net taxable income (i.e. total revenue - total cost).

2.2 Recent Empirical Literature

This literature on this topic is a strand of the more general literature on strategic interactions among governments which could, in principle, compete on several grounds by setting tax or subsidy rates, welfare levels, market regulations and licences, etc. The interaction can also happen at different governmental levels such as national, states or local governments. However, there is a striking similarity of the empirical methodology employed by these studies regardless of the subject and level of competition and the workhorse regression equation that has been commonly used has a general panel specification of the form

$$G_{it} = \rho \bar{G}_{it} + X'_{it}\beta + \mu_i + \lambda_t + u_{it}, \qquad (2.1)$$

where*G* is a measure of government policy instrument (e.g. a tax rate, a subsidy rate, etc.), subscript *i* refers to the competitors (state governments within a country, national governments of competing nations, etc.) and subscript *t* denotes the observation date. The competition effect is captured by a weighted average of the values of the policy instrument set by the competitors, namely $\bar{G}_{it} = \sum_{j \neq i} \omega_{ijt} G_{jt}$ where ω_{ijt} is a non-negative weight which signifies the importance of the role assigned to country *j* by country *i*. Thus, (2.1) is an attempt to capture empirically a symmetric reaction function where the parameter of interest is ρ. To estimate this robustly, a vector of country-specific control variables *X*(including, e.g., demographic variables, country's characteristic, etc.) as well as country and time fixed effects, μ and λ respectively, are added and the random disturbance term u_{it} is expected to exhibit the standard regularity conditions, ideally being a white noise.

Brueckner (2003) reviews the empirical studies on strategic interaction among governments. The earliest paper in the literature is the study by Case, Rosen

and Hines Jr (1993) who used an equation similar to (2.1) and annual data on the continental United State over the period 1970-1982 to study the interdependence of state-level expenditure setting. They assumed that a state's per capita expenditure depends on its own characteristics as well as the expenditures of its neighbours. To capture the effect of the neighbouring states, they constructed variable using a weighting scheme which encompassed several criteria, namely neighbours with (i) common borders, (ii) similar incomes, and (iii) similar black population. They found that a state's level of per capita expenditure was positively affected by the expenditure levels of its neighbours. They also found that failure to account for the so called 'neighbour effect' would lead to a substantial upward bias in the estimates. Kelejian and Robinson (1993),Murdoch, Rahmatian and Thayer (1993) provide similar empirical analyses.

Focusing on the tax competition literature, we can distinguish between two different types of studies. One type consists of those which analyse a leader-follower type behaviour, that although might be a more appropriate characterisation of what happens within a country between the central government and lower governmental levels, has also been used to analyse inter-governmental competition. Examples can be found in studies by Besley and Rosen(1998), Goodspeed (2002, 2000), Hayashi and Boadway (2001) and Esteller-Moréand Solé-Ollé(2001). Altshuler and Goodspeed (2002) applied this approach within the context of global tax competition between countries. They estimated the reaction of countries to tax changes of other countries with the possibility of a large country acting as a Stackelberg leader in setting its capital tax policy. They used data for 1968 to 1996 from the OECD Revenue Statistics to empirically test a model in which the US, the UK, or Germany could act as a Stackelberg leader. Their basic empirical specification was of the form

$$T_{it} = \rho T_{it-1}^{L} + \phi \overline{T}_{it} + X_{it}'\beta + \mu_i + \lambda_t + u_{it}, \qquad (2.2)$$

which is similar to (2.1). T_{it} denotes the follower country's tax rate measure who reacts to both, the tax rate set by the country it considers as leader, T_{it-1}^{L}, and the weighted average of the tax rates set by other followers, $\overline{T}_{it} = \sum_{j \neq i} \omega_{ijt} T_{jt}$. They found that the European countries behaved as if the US was the Stackelberg leader in setting corporate taxes after 1986, the year of the major US tax reform. They also broke the sample into two periods encompassing the first and last ten years of data and estimated the corresponding reaction functions to test whether strategic interaction between European countries had intensified in recent year. They found that European countries seemed to have become more intensely competitive with the US in corporate taxes, but less intensely competitive among themselves.

The second type of empirical study of tax competition focuses on the estimation of Nash reaction functions for the countries involved. We shall use this approach in this chapter. Recent applications can be found in Devereux, Lockwood and Redoano (2008) and Overesch and Rincke (2011) which we briefly describe below.

Devereux, Lockwood and Redoano (2008) investigate whether there has been a significant incidence of tax competition between OECD countries. They develop a theoretical model to illustrate why governments use both statutory tax rates (CITR) and effective marginal tax rates (EMTR) to attract capital and profits, respectively. Although their theory allows for each country to respond differently to a change in the tax rate by each of the other countries, doing so results in an identification problem in estimation as it involves estimating a large number of parameters with insufficient degrees of freedom. They circumvent this problem by imposing a pre-

determined weighting scheme that reflects the extent of relative competition and assume that every country responds to the change in the weighted average of the tax rates of the competitors in the same way. They propose to test their theory by estimating the following panel-based regression equations

$$T_{it} = \phi_T \bar{T}_{it} + \theta_T \bar{E}_{it} + X'_{it}\beta_{T_i} + \mu_{T_i} + \lambda_{T_t} + u_{T_{it}}, \quad (2.3)$$

$$E_{it} = \phi_E \bar{T}_{it} + \theta_E \bar{E}_{it} + X'_{it}\beta_{E_i} + \mu_{E_i} + \lambda_{E_t} + u_{E_{it}}, \quad (2.4)$$

where T and E are measures of CITR and EMTR respectively, $\bar{T}_{it} = \sum_{j \neq i} \omega_{ijt} T_{jt}$ and $\bar{E}_{it} = \sum_{j \neq i} \omega_{ijt} E_{jt}$ are the weighted average tax rates of other countries based on some weighting scheme that determines ω_{ijt}, μ and λ denote the country and time fixed effects respectively, and u_{Tit} and u_{Eit} are random disturbance terms that are expected to satisfy the required regularity conditions (e.g., being independently distributed with a zero mean, etc.). Since the theoretical model allows for the possibility that the tax rates are jointly determined, they propose to use the appropriate two-stage estimation method so as to take the endogeneity of regressors into account. They suggest that the estimation could be carried out with three different weighting schemes: (i) uniform weights, (ii) weights based on the size of the economy measure by the respective GDPs, and (iii) weights based on the openness of the economy measured by the ratio of the sum of FDI inflows and outflows (over three preceding years) to GDP. They also construct the weighted averages of each of the control variables (using the same scheme) in other countries which they use as instruments for the endogenous variables. Using data from 21 OECD countries during the 1988-1999 period, they find evidence supporting their conjecture that a country's CITR

and EMTR are positively affected by that of its competitors. But they fail to find any evidence of cross-tax effect as $\theta_T = 0$ and $\phi_E = 0$ cannot be rejected. As for the explanatory role of control variables, they find that both the highest personal income tax rate and measures of the size of the economy have positive effects on the statutory rates whilst those regressors that capture the demand for public spending and the ideological stance of the policy authorities have no significant effect.

Overesch and Rincke (2011) focus on explaining the recent decline of statutory corporate tax rates and the effective marginal and average tax rates in Europe. They follow the general methodology proposed by Devereux, Lockwood and Redoano (2008) but include the past value of the tax rates that appear as explanatory variables to account for the sluggish adjustment of tax rates over time. They argued that this would allow a comparison between short-run (strategic) and long-run tax competition effects. However, they disregard the cross-tax effects and estimate variants of the following specification

$$T_{it} = \rho T_{it-1} + \phi \bar{T}_{it-1} + X'_{it}\beta + \mu_i + \lambda_t + u_{it}, \qquad (2.5)$$

which is similar to (2.3) but omits any cross tax effects and instead includes the lagged dependent variable. It also uses the lagged value of $\bar{T}_{it} = \sum_{j \neq i} \omega_{ijt} T_{jt}$ to capture the competition effect. For ω_{ijt}, they use the geographical distance-based weights defined as $\omega_{ij} = d_{ij}^{-2} / \sum_j d_{ij}^{-2}$ where d_{ij} is the distance between countries *i* and *j*. They estimated the above model (applying both OLS and two-stage estimation methods) for three measures of T − the statutory corporate tax rates, the effective marginal and average tax rates; CITR, EMTR and EATR respectively − using a sample of unbalance panel data consisting of 32 European countries during the 1983-2006

period. They find a strong lagged depended variable effect to be present in all three cases but as far as the competition effect is concerned only CITR is found to strongly react to competition significantly; competition over EATR is found to be weak and no evidence of competition over EMTR seem to be present. As for the role of the other explanatory variables, they find some evidences that a country's personal income tax rate affects all three rates, and the population dependency factor affects CITR and EATR. They also experiment with a number of alternative weighting schemes use the results to argue that their evidence is based on a robust specification.

In addition to the above studies which will guide our analysis in the rest of the chapter, there are also a number of empirical papers that do not fall into the classification discussed above but are nevertheless relevant to our study. One particular study amongst these is by Slemrod (2004) who investigated the decline of statutory and effective tax rates which begun in the 1980s. The author examined whether this decline was due to changes in domestic factors or it was caused by the international tax competition pressure. Using the ratio of corporation income tax revenue to GDP as a proxy for the effective tax rate and data for 1980, 1985, 1990 and 1995, the author implemented both pooled cross-sectional analyses and fixed effects estimation approach to examine the explanatory role of openness indicators − Sachs-Warner index and (imports+exports)/GDP − and personal income tax rates, controlling for ratio of central government expenditure to GDP, electricity usage, expenditure on crude oil, population and time fixed effects. The results indicated that openness had a negative impact on the tax rates which the author interpreted as competition effect, suggesting that the increasing openness puts pressure on countries to reduce its tax rates to remain competitive. Evidence also implied that the statutory

tax rate was a backstop for the personal income tax rate. The government expenditure was found to play a weak but positive impact on the effective tax rates.

2.3 Empirical analysis

In this section we empirically investigate whether the reduction in CITR and EMTR in the EU countries can be explained by governments competing to attract freely mobile capital. Additionally, given the enlargement of the EU in 2004, we try to examine how competition features in determining the reaction of the two groups of countries which joined the EU at different times. We use data from 21 EU countries during the 2000-2009 period and our sample of countries can be divided into two groups consisting of the existing member countries (the 15 countries which were already a member of the EU in 2000, denoted by EU15) and the new member countries (those which joined in 2004, denoted by EU04). In order to investigate whether the declining corporate income tax rates can be explained by the competition between these countries, we start the empirical estimation using only the data from the group of EU15 and then expand our sample to include EU04. In addition to providing evidence on the impact of EU enlargement on the extent of competition − or whether the accession of the new member countries intensified the incidence of tax competition − this exercise will provide a further robustness check for our empirical methodology.

2.3.1 Econometric specification

As far as the specification of the regression equations and the estimation methodology are concerned, we follow the approach used by Devereux, Lockwood and Redoano (2008) which we explain here in more detail. On the assumption that

governments use CITR and EMTR to attract profits and capital respectively, we use the following two empirical specifications

$$T_{it} = \sum_{j \neq i} \left(\phi_{T_{ij}} T_{jt} + \eta_{T_{ij}} \left(P_{it} \cdot T_{jt} \right) + \theta_{T_{ij}} E_{jt} \right) + \delta_{T_i} P_{it} + X'_{it} \beta_{T_i} + u_{T_{it}}, \tag{2.6}$$

and

$$E_{it} = \sum_{j \neq i} \left(\phi_{E_{ij}} T_{jt} + \eta_{E_{ij}} \left(P_{it} \cdot E_{jt} \right) + \theta_{E_{ij}} E_{jt} \right) + \delta_{E_i} P_{it} + X'_{it} \beta_{E_i} + u_{E_{it}}, \tag{2.7}$$

where T and E are measures of CITR and EMTR respectively, P is a measure of the personal income tax rates (PITR), X is a vector of the relevant country-specific conditioning variables, u is the disturbance term of the regression, subscripts i and j refer to the countries and the subscript t denotes the observation date. The main parameters of interest are $\phi_{T_{ij}}$ and $\theta_{E_{ij}}$ and a careful choice of the additional regressors in the above specifications should reduce biases due to omissions and give rise to robust estimates. Empirical support for our hypothesis requires (i) either or both of $\phi_{T_{ij}}$ and $\theta_{E_{ij}}$ to be significantly positive so that a reduction in CITR or EMTR in the EU countries can be explained by intergovernmental tax competition; and (ii) either or both of $\phi_{E_{ij}}$ and $\theta_{T_{ij}}$ to be statistically significant for there to be cross tax competition amongst governments. Additionally, substitutability between CITR and EMTR would require $\phi_{E_{ij}} < 0$ and $\theta_{T_{ij}} < 0$.

The inclusion of the country's personal income tax rate, P_{it}, is justified by Devereux, Lockwood and Redoano (2008) who explain that since "*in the absence of corporation tax, individuals could potentially escape tax on their earnings by*

incorporating themselves" corporation tax is a necessary backstop for income tax. They use the highest domestic income tax as a proxy for this.[2] In addition, the inclusion of the interaction effects $P_{it} \cdot T_{jt}$ and $P_{it} \cdot E_{jt}$ reflects the assumption that the spill-over effects from a competing country's tax policy is captured by a direct effect and an indirect effect. That is for each country $i \neq j$,

$$\frac{\partial T_{it}}{\partial T_{jt}} = \phi_{T_{ij}} + \eta_{T_{ij}} P_{it},$$

and

$$\frac{\partial E_{it}}{\partial E_{jt}} = \theta_{E_{ij}} + \eta_{E_{ij}} P_{it}.$$

This aspect of the above specifications is guided by the reported evidence, which suggests that a country's personal income taxation policy is also likely to be taken into account by the investors when allocating their investments. More precisely, it is expected that $\eta_{T_{ij}} < 0$ and $\eta_{E_{ij}} < 0$ so as to reflect the observation that a rise in the country's personal income tax rate enhances the impact of international tax competition.

The elements vector *X* and the justification for their role in the regression equations are listed below.

- *GDP* and population (denoted by *POP*) to account for country size − the latter was also used in Overesch and Rincke Overesch and Rincke (2011).
- The ratio of the government expenditure to GDP and the ratio of dependent population to total population to proxy the demand for public spending

[2] Slemrod (2004) and Overesch and Rincke (2011) also included a similar explanatory variable to capture this effect and found it to play a significant role.

(denoted by *GOV/GDP* and *POPDEP/POP*, respectively) − both Devereux, Lockwood and Redoano (2008) and Overesch and Rincke (2011) use the ratio of young and old (under 15 and over 65) in total population as the proxies for the latter.

- The ratio of central government debt to GDP (denoted by *DEBT/GDP*)as proxy for public borrowing. Hayashi and Boadway (2001) argue that government policy is subject to an intertemporal budget constraint, in which either tax rises or spending cuts is imminent after high budget deficits. Therefore they use government's net lending as proxy for public deficits, which is one of the control variables that may influence tax decisions.
- The ratio of capital income tax to total tax revenue (denoted by *CITREV/TAXREV*)as proxy for demand for CIT reduction — because policymakers, who commonly believe that all taxes have weaknesses and tax system should not rely on any given tax(Slemrod, 2004), may have an incentive to reduce a tax rate so as the ratio of country's capital income tax to total tax revenue is not too high.

On the grounds that the effect of the above exogenous variables could be argued to be sluggish, it might be more appropriate to use their lagged values in the estimation.

The estimation of equations (2.6) and (2.7), however, is problematic due to their over-parameterization. In order to avoid this problem, we follow the methodology described above of using predetermined weights and assuming that governments respond to some weighted average of their competitors' tax rates. Thus, we use proxy variables that can robustly capture the effect of linear combinations

$$\sum_{j\neq i}\left(\phi_{T_{ij}}T_{jt}+\eta_{T_{ij}}\left(P_{it}\cdot T_{jt}\right)+\theta_{T_{ij}}E_{jt}\right),$$

and

$$\sum_{j\neq i}\left(\phi_{E_{ij}}T_{jt}+\eta_{E_{ij}}\left(P_{it}\cdot E_{jt}\right)+\theta_{E_{ij}}E_{jt}\right),$$

and instead of (2.6) and (2.7), we work with

$$T_{it}=\phi_{T_i}\bar{T}_{it}+\eta_{T_i}\left(P_{it}\cdot\bar{T}_{it}\right)+\theta_{T_i}\bar{E}_{it}+\delta_{T_i}P_{it}+X'_{it}\beta_{T_i}+u_{T_{it}}, \tag{2.8}$$

$$E_{it}=\phi_{E_i}\bar{T}_{it}+\eta_{E_i}\left(P_{it}\cdot\bar{E}_{it}\right)+\theta_{E_i}\bar{E}_{it}+\delta_{E_i}P_{it}+X'_{it}\beta_{E_i}+u_{E_{it}}, \tag{2.9}$$

where $\bar{T}_{it}=\sum_{j\neq i}\omega_{ijt}T_{jt}$, $\bar{E}_{it}=\sum_{j\neq i}\omega_{ijt}E_{jt}$ and ω_{ijt} is, as before, a spatial weight that signifies the importance of the role assigned to country *j* by country *i* at time *t*.

Given a sample of *n* countries and *t* years − that is *i* and *j*=1,…,*n* and *t*= 1,...*t*− estimating (2.8) and (2.9) for each country at a time would be problematic when *n* is relatively large (due to degrees of freedom and estimation inefficiency problems). We shall therefore estimate the panel version of the above equations which allow for country and time fixed effects, namely

$$\begin{aligned}T_{it}=&\phi_T\bar{T}_{it}+\eta_T\left(P_{it}\cdot\bar{T}_{it}\right)+\theta_T\bar{E}_{it}+\delta_T P_{it}\\&+X'_{it}\beta_T+\mu_{T_i}+\lambda_{T_t}+u_{T_{it}},\end{aligned} \tag{2.10}$$

and

$$\begin{aligned}E_{it}=&\phi_E\bar{T}_{it}+\eta_E\left(P_{it}\cdot\bar{E}_{it}\right)+\theta_E\bar{E}_{it}+\delta_E P_{it}\\&+X'_{it}\beta_E+\mu_{E_i}+\lambda_{E_t}+u_{E_{it}}.\end{aligned} \tag{2.11}$$

The endogeneity of some of the regressors is another issue that needs specific attention. The above specifications are based on the Nash equilibrium framework − see Devereux, Lockwood and Redoano (2008) − which, on the assumption that tax

rates are determined and announced contemporaneously and in advance each year, require using the current values of $\overline{T}_i$, $\overline{E}_i$ and P_i as regressors. Therefore, in our estimation we also need to take into account the fact that the tax rates are jointly determined and treat $\overline{T}_i$, $\overline{E}_i$ and P_i as endogenous regressors. This requires identifying the appropriate instrumental variables and using the appropriate two-stage estimation method in order to obtain consistent estimates of the parameters. For the choice of instrumental variables, we follow Devereux, Lockwood and Redoano (2008) and use for each country the weighted average of the exogenous variables of the other countries as the instruments where the weights are the same as those used in generating $\overline{T}_i$ and $\overline{E}_i$.

The final estimation issue concerns the choice of weights, ω_{ijt}, that country *i* assigns to country *j*'s action at time *t*. Clearly, we need to impose $\omega_{iit} = 0$ and $\sum_j \omega_{ijt} = 1$ for all *i* and *t* where $\omega_{ijt} \geq 0$ for all *i*, *j* and *t*. As for the choice of ω_{ijt}, the literature offers a number of options of which the uniform weight $\omega_{ijt} = (n-1)^{-1}$ is the obvious candidate − where *n* is the number countries, also used by Devereux, Lockwood and Redoano (2008) − and the resulting estimates could constitute a benchmark. The main disadvantage of this method, apart from disregarding variations in the intensity of competition between countries, is that the regression equations (2.10) and (2.11) can be reparameterised so that $\overline{T}_{it}$ and $\overline{E}_{it}$ on the right-hand-side of are replaced with $\overline{T}_t = \sum_{j=1}^{n} T_{jt}$ and $\overline{E}_t = \sum_{j=1}^{n} E_{jt}$ respectively. But these will be perfectly correlated with the time dummies and hence their coefficients will not be identified. The solution offered by Devereux, Lockwood and Redoano (2008)

in this case is to replace the time dummies with country-specific time trends in estimation. We shall follow this strategy too.

Given the shortcomings of the uniform weighting scheme, attempts have been made at using different weights. Portes and Rey (2005) argue that information frictions are positively correlated with distance. Geographical distance is a barrier to interaction among economic agents. They find evidences that trade and assets investment are negatively correlated with the geographical distance between countries. The longer the distance the more disincentive the investors have on the investment. Accordingly, it is justifiable to assume that, other things equal, tax policies of immediate neighbouring countries have stronger effects than that of the more distant countries. Therefore, we also use the normalised weights $\omega_{ij} = d_{ij}^{-2} / \sum_{j} d_{ij}^{-2}$ as our second choice where d_{ij} is the distance between countries *i* and *j* and is quantified on the basis of bilateral distances between capital cities − as calculated by Mayer and Zignago (2011).

The third choice for ω_{ijt} is a competition-based weight which uses the contiguity relations between countries and some form of it is often used in econometric studies involving a spatial dimension that is determined by some type of competition between the panel members. One way to construct this measure is to assume that those countries which are direct competitors would act as if they are contiguous countries. This requires identifying which countries are direct competitors. In the case of tax competition considered here, it would be plausible to assume that those countries which specialize in the production and export of the same category of goods are likely to be the direct competitors. To identify the competitors within this framework first for each country we rank its export volumes by category using disaggregate exports data at two-digit level SITC rev.2 definition

provided by the OECD. We then use this ranking to compare the classifications of three highest export volumes across countries. Countries which share at least one category of export goods in their list of the three highest export volumes are assumed to be direct competitors. For each two direct competitors we define a dummy $\upsilon_{ijt} = 1$, let $\omega_{ijt} = 1/\sum_j \upsilon_{ijt}$ for these countries and set $\omega_{ijt} = 0$ for all *i*=*j* and for all *i* and *j* that are found not to be in direct competition. It is worth noting that ω_{ijt} defined in this way could, in principle, vary over time as countries change their specialization in trade. Also, although this scheme only 'matches' those countries that are in direct competition, it also allows for spill-over effects from other (not directly competing) countries via indirect competition. To clarify this, consider three countries indexed by *i*, *j* and *k* and suppose that *i* is in direct competition with *j* but not with *k*. However, if *j* and *k* happen to be in direct competition then this weighting scheme allows for spill-over effect from *k* to *i* via its direct competition with *j*.

2.3.2 Data

As mentioned above, we shall use annual data from 21 EU countries (denoted by EU21) for the period 2000-2009. These countries can be divided into two groups. The first group (denoted by EU15) consists of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherland, Portugal, Spain, Sweden and UK, which were already EU members in 2000. The second group (denoted by EU04) includes Czech Republic, Estonia, Hungary, Poland, Slovak Republic and Slovenia, which joined the EU in 2004.

The main variable of interest in our analysis is a measure of corporate income tax rate. While this rate can be measured in several ways, we shall focus on two specific measurements: the statutory capital income tax rate (CITR) and a measure

that is based on a theoretical model of investment. The CITR is the headline tax rate that includes both taxes levied by central and local governments. With respect to the theory based measures, two are commonly used in the literature that focuses on measuring the taxation of income from capital. These are the effective marginal tax rates (EMTR), proposed by King Fullerton, Alworth and Alworth(1984), and the effective average tax rates (EATR),proposed by Devereux and Griffith(2003). EMTR is based on the effective tax levels of a hypothetical investment project, which is measured by the difference between the before-tax and the after-tax rates of return on the last dollar invested. EATR is defined as the ratio of the net present value (NPV) of taxes over the NPV of the economic rents earned in the absence of taxation. Thus EATR measures the proportion of the economic rent which is taken in tax. As suggested by Devereux and Griffith (2003), the size of investment would depend on the EMTR. On the other hand, the choice of location of investment depends on the level of post-tax NPV – for a given pre-tax NPV in each location – which can be measured by an EATR. In this instance, the EATR seems to be the more relevant measure in relation to the determinants of firm location choice. However, as suggested by Devereux (2004), the EATR varies according to the rate of profit earned on the investment project, but – in the absence of personal taxes – it converges to the statutory tax rate as the rate of profit rises. Thus, the EATR are expected to be positively correlated with the statutory tax rates. Therefore, it will be difficult to identify competition separately in the CITR and the EATR. Accordingly, we shall focus on two specific measurements; the statutory capital income tax rate (CITR)and the effective marginal tax rate (EMTR).

Figures 2.1 and 2.2 plot the mean of the series across EU21 over the period, with the upper and lower dashed-lines showing the one standard deviations band. These figures illustrate the key features of the two series as summarised below.

CITR: The mean gradually decreases from 32.29% in 2000 to 25.53% in 2009 and the standard deviation also falls from 8.64% to 5.79%. During this period, almost all countries reduced their CITR. However, Ireland which has maintained the lowest rate throughout the sample period is the only country in our sample that increased its CITR in 2003 from 10% to 12.5%. In 2000, Germany had the highest CITR at 52.35% − which comprises of central government (federal) corporate income tax rate, surcharge rates and local profit tax rate − which was reduced to 39.35% in 2001. Spain's rate was slightly higher than 40% until 2006 but it started to reduce afterwards. Belgium and Italy also had their rate slightly higher than 40% during 2000–2002.

EMTR: The series were extracted from the report for the EU Commission 'Effective tax levels using the Devereux/Griffith methodology' − see Devereux, Elschner, Endres and Spengel (2009). The measure used here is the average rate of the investments in five different assets (industrial buildings, intangibles, machinery, financial assets and inventories) and three different financing methods (retained earnings, new equity and debt). The pattern of EMTR is slightly different from that of CITR; starting at 20.73% in 2000 and moderately increasing to 21.16% in 2002 then continually falling to 16.89% in 2009, which is a comparatively smaller decline than that experienced by CITR. The standard deviation, which initially fell from 8.62% in 2000 to 7.34 % in 2003, rose to 8.81% in 2009 showing that unlike CITR its dispersion rose over the period. Whilst in Denmark, Estonia, France, Spain, Sweden and the UK the EMTR remained relatively stable throughout our sample

period. In Austria, Belgium[3], Czech Republic, Germany, Finland, Greece, Hungary, Luxemburg, Netherland, Poland, Portugal and Slovak it fell in the second half of the decade. In Ireland, Italy and Slovenia the rate rose over the period.

Thus, on the whole, data indicates that there has been a tendency for corporate income tax rates in the EU countries to reduce. Also, as indicated by the reduction in the variance of CITR, there is some tendency for the actual rates to converge. These observations could be interpreted as preliminary evidence supporting the existence of a race-to-the-bottom in tax competition among EU countries and could therefore be of policy concern for governments.

Assuming that some form of race-to-the-bottom in tax competition did occur, it would be of interest to examine whether policies of using corporate income tax to compete over attracting investment have been effective. This leads to our first question regarding the relationship between investment and CITR and EMTR. We use Foreign Direct Investment (FDI) inflows data provided by OECD to proxy the investments. Figures 2.3 and 2.4 plot the mean of the FDI inflows for EU21 against that of CITR and EMTR respectively and show that on the whole a positive correlation between FDI and the two rates. However, there are some anomalies that throw doubt on the validity of this conclusion: (a) the high level of FDI inflow seems to occur at the intermediate levels of CITR and the very high rates are not attracting much more than the very low rates; (b) there are relatively high levels of FDI inflow associated with negative EMTR. It therefore seems that investment flows do not fully depend on CITR or EMTR and there are other important factors that affect investors' decisions to allocate their investment.

[3] Belgium was the only country that had negative EMTR during 2007 to 2009, mainly resulting from the negative returns from the investment in intangibles and machinery.

The second question that arises in the above context is whether the tax reduction was caused by tax competition in the first instance. On the grounds that tax competition would result in loss tax revenue from corporate income, it is worthwhile to examine the tax revenue series. We use OECD data on revenue from corporate income tax (CITREV) provided by central governments. As shown in Figure 2.5, the mean of CITREV for EU21 exhibits a different pattern from that of CITR, rising (after a small initial fall) until 2008 and drastically dropping back to its initial level in 2009. While for most countries this revenue was relatively unchanged during the period, Germany, Spain, France, the UK and Italy experienced a rise until 2008 and a substantial drop in 2009. Given that both the initial and the final reductions are likely to be due to recessions that affected the EU countries (amongst others), the observed pattern does not confirm the occurrence of tax competition. It may be argued that governments have broadened their tax base, while engaging in tax competition, in order to ensure revenue neutrality. But if this was the case and the broadening of tax base achieved its aim across all investments, then we should observe a positive correlation between EMTR and CITREV. As it happens, these series do not satisfy this requirement.[4]

The last question we consider here is whether there are other factors that have led governments to adjust CITR. On the ground that a government may have other reasons to adjust its corporate income tax policy rather than just engaging in tax competition, we would examine the share of governments' revenue from corporate income tax as percentage of total tax revenue (denoted by *CITREV/TAXREV*). We use OECD data on revenue from corporate income tax as well as total tax revenue to calculate *CITREV/TAXREV* for EU21. As shown in Figure 2.6, the mean of

[4] This does not rule out the possibility that the broadening of tax base has had a partial effect.

CITREV/TAXREV for EU21 exhibits a similar pattern to that of the mean of CITREV. For almost all countries, *CITREV/TAXREV* rose between 2003 and 2007 and then had a drastic drop in 2008 and 2009 beyond its initial level. The general reductions in *CITREV/TAXREV* are likely to be due to the recessions during 2000-2001 and 2008 onward, while the increase in the 2003-2007 period corresponds to the expansion of the EU economy. Luxembourg and Ireland, whose shares of *CITREV/TAXREV* were among the highest in EU21, had their share of *CITREV/TAXREV* decreased since 2002. Whilst, Germany and Austria, whose shares of *CITREV/TAXREV* were among the lowest in EU 21, had their share of *CITREV/TAXREV* increased during 2003-2007. During the growth periods, governments' revenue from both income and consumption taxes is likely to increase. Countries whose share of *CITREV/TAXREV* was high would be able to use the reduction in corporate income tax to achieve their targets in tax diversification and tax competition. However, countries with a low share of *CITREV/TAXREV* might not be able to reduce their CIT rate as low as they need to compete with other countries. It is therefore possible that the reduction in corporate income tax might be, at least partially, the result of tax competition.

On the whole, it is plausible to expect firms not to consider only the level of capital income tax rates when choosing the location of their investments. There are several relevant factors, e.g., the size of domestic market, the cost of production, the level of productivity, etc., that firms would care about. If a country has advantages in these factors over other countries, then it is likely to attract firms despite its relatively higher tax rate. In other words, such advantages would allow governments to keep their existing CITR policy unchanged and still maintain their investment inflow. Therefore, factors which give rise to such advantages ought to be used as

conditioning variables in an empirical study that attempts to quantify the impact corporate taxation policy in the context of tax competition.

2.3.3 Regression results

We have used the data described above to estimate regression equations (2.10) and (2.11). The results are presented in three sets of Tables. In Tables 2.1 and 2.2 we report the estimates using data for the original EU15 countries which were in the EU in year 2000. In Tables 2.3 and 2.4 we report the estimates for the extend sample of countries, i.e. EU21 which include the other 6 countries that joined the EU in 2004. Finally, in Tables 2.5 and 2.6 we report estimates of modified versions of regression equations (2.10) and (2.11) which include additional regressors to capture the effect of EU enlargement in 2004. In each of these Tables we report two sets of estimates, one excluding and one including the cross tax effect, and for each set we present the two-stage estimates for the three weighting schemes discussed above (see above for the choice of instruments). Below we provide a summary of our finding based on the reported evidence in these Tables.

The results based on EU15 reported in Tables 2.1 and 2.2 suggest that:

- Distance-based weighting scheme seems to be the only one that leads to significant competition effect as the coefficients of the relevant tax rates, $\overline{T}_{it}$ in Table 2.1 and that of $\overline{E}_{it}$ in Table 2.2, and of the personal tax rate P_{it} and its interaction with the former are significant only in this case.
- There is no evidence of significant cross-tax competition amongst these countries (as estimates reported in columns indicated by "*Including Cross Tax Effect*" show), since the coefficient of $\overline{E}_{it}$ in Table 2.1 and that of $\overline{T}_{it}$ in Table 2.2 are statistically insignificant.

- Denoting the estimates by a '^' over the parameters, we obtain $\hat{\phi}_T > 0$; $\hat{\phi}_E < 0$; $\hat{\eta}_T < 0$; $\hat{\eta}_E > 0$.
- $\phi_T > 0$ confirms our hypothesis that there is tax competition among EU15 countries. $\phi_E < 0$ suggests that governments may not use EMTR in competition over investment.
- $\theta_T < 0$ ($\theta_E > 0$) suggests that P_{it} has a positive (negative) impact on $\overline{T}_{it}$ $\left(E_{it}\right)$ which is compatible with the findings in the literature indicating that governments may use corporate income tax – statutory corporate income tax rate in particular − as a backstop to the reclassification of labour income as business income.
- The positive (negative) impact of P_{it} on T_{it} (E_{it}), however, is dampened by the interaction effect − with $\overline{T}_{it}$ ($\overline{E}_{it}$). $\hat{\eta}_T < 0$ suggests that the higher is the level of PITR (intergovernmental CITR competition) the lower is going to be the overall impact of intergovernmental CITR competition (PITR). Put differently, at sufficiently low levels of international CITR, increasing levels of personal income taxation puts upward pressures on the level of countries' CITR, while the opposite will happen when levels of international CITR is sufficiently high. $\eta_E > 0$ suggests that the higher is the level of PITR (intergovernmental EMTR competition) the lower is going to be the overall negative impact of intergovernmental EMTR competition (PITR). At sufficiently high levels of PITR, the overall impact of intergovernmental EMTR can be positive. Accordingly, governments may use CITR as a backstop to the reclassification of labour

income tax and instead consider reducing EMTR − which does not affect the reclassification − to compete over attracting investment.

- The market size factors, *GDP* and population, have positive impacts on both T_{it} and E_{it}, although *GDP* does not seem to have a statistically significant impact. This may reflect the possibility that there exists an agglomeration rent in large economies so that governments can tax their own industry at a marginally higher rate.
- The demand for public spending factors, *GOV/GDP* and *POPDEP/POP*, have negative (positive) impacts on T_{it} (E_{it}) although *GOV/GDP* does not seem to have a statistically insignificant impact. This may reflect that a government might prefer to increase effective marginal tax rate to finance increasing demand for public spending rather than raise corporate income tax rate.
- We find that the demand for CIT reduction (*CITREV/TAXREV*) and public borrowing factor (*DEBT/GDP*) are statistically insignificant.
- As far as the general diagnostics are concerned: (i) R^2s suggest a reasonable degree of explanation (given the panel nature of the data); (ii) Akaike information criterion (AIC) and Schwarz's Bayesian information criterion (BIC) in Tables 2.1 (2.2) indicate that the model including (excluding) the cross tax effect fits the data, using distance-based weighting scheme, slightly better; (iii) Anderson's canonical correlation test rejects the null hypotheses that the equation is under-identified; (iv) Cragg-Donald's test fails to reject the null hypotheses that the equation is weakly identified; and (v) Sargan's test in Table 2.1 (Table 2.2) fails to reject (rejects) the null hypotheses that the instruments are uncorrelated

with the error term. Thus, we may conclude that the estimates are asymptotically biased and hence the results should be interpreted with caution.

The above results lend overall support to the hypotheses that there exists inter-governmental tax competition amongst EU15 countries over attracting investment. We then extend the sample of countries to include the other 6 countries that joined the EU in 2004. The estimates based on EU21 countries are reported in Tables 2.3 and 2.4 and suggest that:

- In this case, too, the distance-based weighting scheme yields significant coefficient estimates for both measures of tax rates, $\overline{T}_{it}$ in Table 2.3 and that of $\overline{E}_{it}$ in Table 2.4, as well as for the personal tax rate P_{it} and its interaction terms. The uniform weighting scheme leads to significant coefficient estimates for $\overline{T}_{it}$ in Table 2.3 and for P_{it} and its interaction term.
- Comparing the estimates for the extended sample with those based on the original EU15 countries we find comparable effects of competition of the relevant tax rates and improvement in the significance level of the estimated coefficients.
- In Table 2.3, the results based on uniform weighting scheme show both market size factors (*GDP* and population) and the demand for public spending factor (*POPDEP/POP*) to be statistically significant. Using the distance-based weighting scheme, as before we find *GDP* not to have a statistically significant role.
- The results using distance-based weighting scheme in Table 2.4 show that the demand for corporate income tax reduction (*CITREV/TAXREV*)

has a significant impact on EMTR, suggesting some evidence for the role of CIT revenue in preventing the government from reducing EMTR to compete over attracting investment. The demand for public spending factor (*POPDEP/POP*) is also statistically significant in this case.

- As far as the diagnostics are concerned, (i) R^2s suggest a reasonable degree of explanation (given the panel nature of the data); (ii) AIC and BIC indicate that the model excluding the cross tax effect fits the data slightly better; (iii) Anderson's canonical correlation test rejects the null hypotheses that the equation is under-identified; (iv) Cragg-Donald's test fails to reject the null hypotheses that the equation is weakly identified; and (v) Sargan's test fails to reject the null hypothesis that the instruments are uncorrelated with the error term in Table 2.3 under uniform weighting scheme and in Table 2.4 under distanced-base weighting scheme, while it rejects the null hypothesis in Table 2.3 under distance-based weighting scheme. Therefore, this suggests giving more weight to the case of uniform weighting scheme in Table 2.3 and to the distance-based weighting scheme in Table 2.4, where the instrument sets are feasible.

Finally, we estimate modified versions of regression equations (2.10) and (2.11) which include additional regressors to capture the effect of EU enlargement in 2004. The results report in Tables 2.5 and 2.6:

- Comparing these estimates to those of in Table 2.3 and 2.4, we find that uniform and distance-based weighting schemes no longer lead to significant competition effect. In fact, the estimates reported in columns indicated by *"Weighting Scheme 3"* under *"Excluding Cross Tax Effect*"

in Table 2.5 seem to be the only ones that lead to significant competition effect in that the coefficients of the relevant tax rates, $\overline{T}_{it}$, and of the personal tax rate P_{it} and its interaction term are significant, although the evidence is somewhat weak statistically. The results reported in Table 2.6 suggest that competition effects are statistically insignificant.

- The additional regressors that capture the effect of EU enlargement in 2004 −estimates reported in rows corresponding to "$\overline{T}_{it}^{EU04}$", "$\overline{E}_{it}^{EU04}$", "$P_{it} \cdot \overline{T}_{it}^{EU04}$" and "$P_{it} \cdot \overline{E}_{it}^{EU04}$"−are all insignificant. This may appear counterintuitive. However, the accession of new countries in 2004 did not happen abruptly. After 1989, the EU had agreements that intended to prepare these countries for eventual accession into the Union. These consisted of bilateral agreements between each other and with the EU to reduce tariffs, and other non tariff barriers (The World Bank, 2005, p.31). These efforts could have led to these countries becoming virtual members of the EU long before the official accession date and this would cast doubt on the econometric tests such as the one used above which is a common practice in the literature.
- As far as the diagnostics are concerned: (i) R^2s suggest a reasonable degree of explanation (given the panel nature of the data); (ii) AIC and BIC in Table 2.5 indicate that the model excluding the cross tax effect fits the data, using competition-based weighting, better; (iii) Anderson's canonical correlation test rejects the null hypotheses that the equation is under-identified; (iv) Cragg-Donald's test statistic is low, therefore, we cannot safely reject the null hypotheses that the equation is weakly

identified even though we do not have Stock-Yoko weak ID test critical value to compare with; and (v) Sargan's test fails to reject the null hypotheses that the instruments are valid: thus, we may conclude that the estimates are asymptotically biased and hence the results should be interpreted with caution; (vi) the χ^2 test for the joint significance of the added variable fails to reject the hypotheses that the model including added variables is correctly specified relative to the model used in Table 2.3 and 2.4.

- Comparing these estimates with those reported in Table 2.5 and 2.6, AIC and BIC indicate that the model excluding the added variables fit the data better. Therefore, we prefer the estimates reported in Table 2.3 and 2.4 over the estimates in Table 2.5 and 2.6.

Given all results of the estimations, the following conclusions can be highlighted:

- There is evidence of significant inter-governmental CITR competition among EU countries, while there is no evidence of significant cross-tax competition amongst these countries.
- Uniform and distance-based weighting schemes seem to be the schemes that lead to significant competition effect as the coefficients of the relevant tax rates, $\overline{T}_{it}$ or that of $\overline{E}_{it}$, and of the personal tax rate P_{it} and its interaction terms are significant when these schemes are used in estimation. This result is consistent with the previous findings in the relevant literature.
- The results reported here are compatible with the finding in the literature that governments might use corporate income tax – statutory corporate

income tax rate in particular – as a backstop to the reclassification of labour income as business income. As a result, a rise in personal tax rates is likely to reduce the international tax competition: the higher is the level of PITR the lower is going to be the overall impact of inter-governmental CITR competition.

- We cannot find any evidence that the additional regressors, which capture the effect of EU enlargement in 2004, are significant. This finding, and the fact that accessions did not in reality occur at a particular date, suggest that we cannot make any claims regarding the hypothesis that the enlargement of EU intensified tax competition among EU countries.

In the light of the above explanations, we choose the estimates reported in Tables 2.3 and 2.4 as our preferred estimations and use the two-stage estimates based on uniform and distance-based weighting scheme under "*excluding cross tax effect*" to analyse the net impacts of inter-governmental tax competition effects, $\overline{T}_{it}$ and $\overline{E}_{it}$. Using the sample information, for each country *i* we measure these effects by $\frac{\partial T_i}{\partial \overline{T}_i} = \hat{\phi}_T + \hat{\eta}_T \overline{P}_i$ and $\frac{\partial E_t}{\partial \overline{E}_i} = \hat{\theta}_E + \hat{\eta}_E \overline{P}_i$ respectively, where $\overline{P}_i$ is the mean values of P_{it} over the estimation period 2000-2009. Table 2.7 reports these values as well as the test statistics for the null hypothesis $\phi_T + \eta_T \overline{P}_i = 0$ and $\theta_E + \eta_E \overline{P}_i = 0$. The following observations are worth considering:

- As the last row of Table 2.7 shows, the full sample indicates that the overall impact of inter-governmental CITR competition is positive while the test statistic fails to reject the null hypotheses that the net impact of inter-governmental EMTR competition is zero. We find that

$\hat{\phi}_T + \hat{\eta}_T \overline{P}_i > 0$ (and it is statistically significant at low confidence levels). This result suggests that inter-governmental tax competition exists among member countries of the EU. The full sample indicates that the total impact of inter-governmental CITR competition evaluated using mean value of P_{it} is greater than unity, at 1.61.

- Despite the differences in terms of model set-up and specification, the results obtained confirm the main finding of Devereux, Lockwood and Redoano (2008) and Overesch and Rincke (2011) regarding the presence of strategic tax competition in statutory corporate income tax rate. However, the magnitudes of inter-governmental CITR tax competition from those two studies are lower than unity: 0.68 and 0.69 respectively. Our results also confirm the finding of Overesch and Rincke (2011) that there is no evidence for competition in effective marginal tax rates in the EU.
- At the individual country level, this result also holds for Denmark, Estonia, Spain, the UK, Greece, Luxembourg, the Netherlands, Poland, Portugal and the Slovak Republic; we find the overall impact of inter-governmental CITR competition to be positive and statistically significant but cannot reject the hypothesis that the inter-governmental EMTR competition does not have a net effect on the specific country's EMTR, i.e., $\hat{\theta}_E + \hat{\eta}_E \overline{P}_i = 0$.
- For Austria, Belgium, Germany, Finland, France, Hungary, Italy, Slovenia and Sweden, the test fail to reject the hypothesis that the inter-governmental CITR competition does not have a net effect on the

specific country's CITR, i.e. $\hat{\phi}_T + \hat{\eta}_T \overline{P}_i = 0$. This result could suggest that for these countries the PITR is sufficiently high on average to compensate the direct impact of inter-governmental CITR competition. In contrast, there seems to be a positive overall impact on inter-governmental EMTR competition in these countries, i.e., $\hat{\theta}_E + \hat{\eta}_E \overline{P}_i > 0$. This might have occurred because these countries have a high level of PITR which may prevent their governments from reducing their CITR. Governments may instead choose to reduce their EMTR which does not affect the reclassification of labour income.

- There are anomalies in the results for Czech Republic and Ireland in that both effects are significant but have the opposite signs: the overall impact of inter-governmental CITR competition is positive but that of inter-governmental EMTR competition is negative. However, $\hat{\theta}_E + \hat{\eta}_E \overline{P}_i < 0$ is statistically significant at a rather low confidence level. It may be argued that these countries have broadened their tax base, while engaging in CITR tax competition, in order to ensure revenue neutrality.

Therefore, we may conclude that different countries may use different tax measures to compete over attracting investment. The high PITR countries may use EMTR while the lower PITR countries may use CITR to compete over attracting investment.

2.4 Conclusion

The absence of trade barriers has led to concerns by policy makers and international institutions such as the OECD and the European Council that it would likely create a race-to-the-bottom type of tax competition. In this chapter, we find evidence that European countries' governments used statutory corporate income tax rates to compete against other countries. At the individual country level, different countries may use different tax measures to compete over attracting investment. Thus, whilst high PITR countries may use EMTR, lower PITR countries may use CITR to compete over attracting investment. These results are also consistent with, and complement, the previous relevant literature.

We also find evidence that governments may use statutory corporate income tax rates − not effective marginal tax rates − as a backstop to the reclassification of labour income as business income. Moreover, we find that increases in personal income tax can reduce the impact of international tax competition. The higher is the level of PITR the lower is going to be the overall impact of inter-governmental CITR competition.

Our attempt to test whether the enlargement of the EU in 2004 has raised the extent of tax competition fails to support this hypothesis: we cannot find any evidence that the accession of the new member countries in 2004 intensified the incidence of tax competition. This result may contradict the beliefs of the policy makers and international institutions. However, the fact that the accession of new member countries in 2004 was the result of an on-going process which was initiated in 1989 and did not happen abruptly casts doubt on the econometric methods used in testing this hypothesis.

It should be noted that, given the problems identified with some of the diagnostic test statistics, there is a case here for using other, more advanced and robust, estimation methods in order to verify our results. Nevertheless, these preliminary results are sufficient to conclude that there has been some degree of tax competitions among European countries over the period considered. However, the empirical analysis cannot be extended to quantify the effects of tax competition on the allocation of capital and ultimately on the welfare of the countries involved. In the rest of the thesis, we assume that inter-governmental competition exists and develop a theoretical model and use it to analyse various aspects of tax competition, specifically addressing these questions.

Appendix

2-A Figures

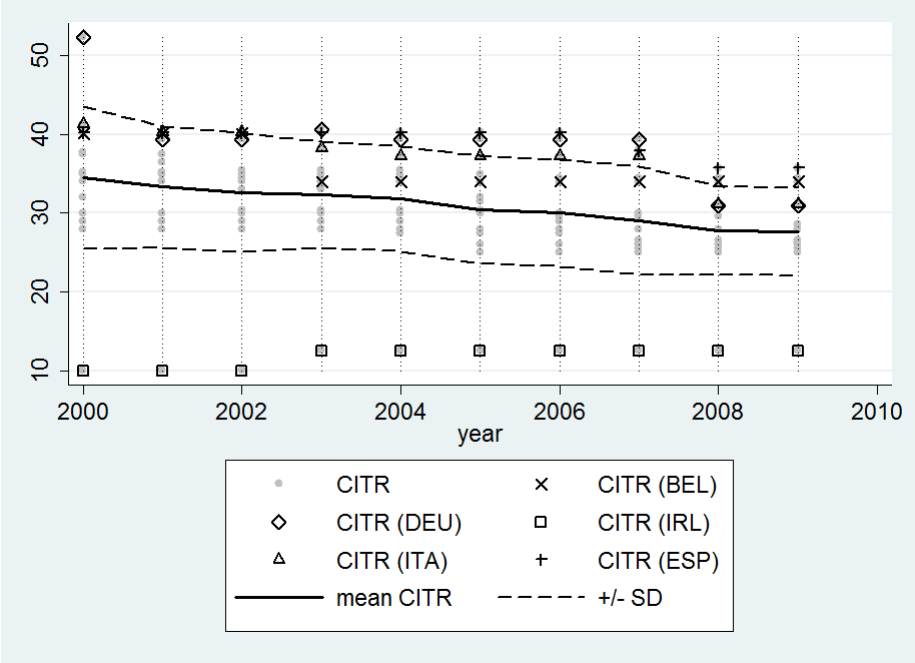

Figure 2.1 Capital Income Tax Rates (CITR for EU21)

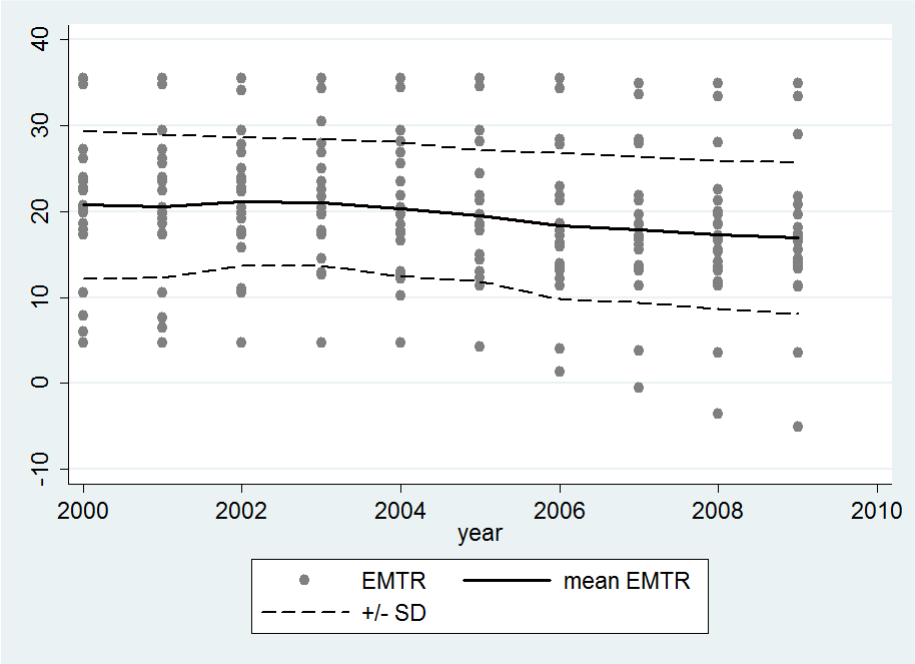

Figure 2.2 Effective Marginal Tax Rates (EMTR for EU21)

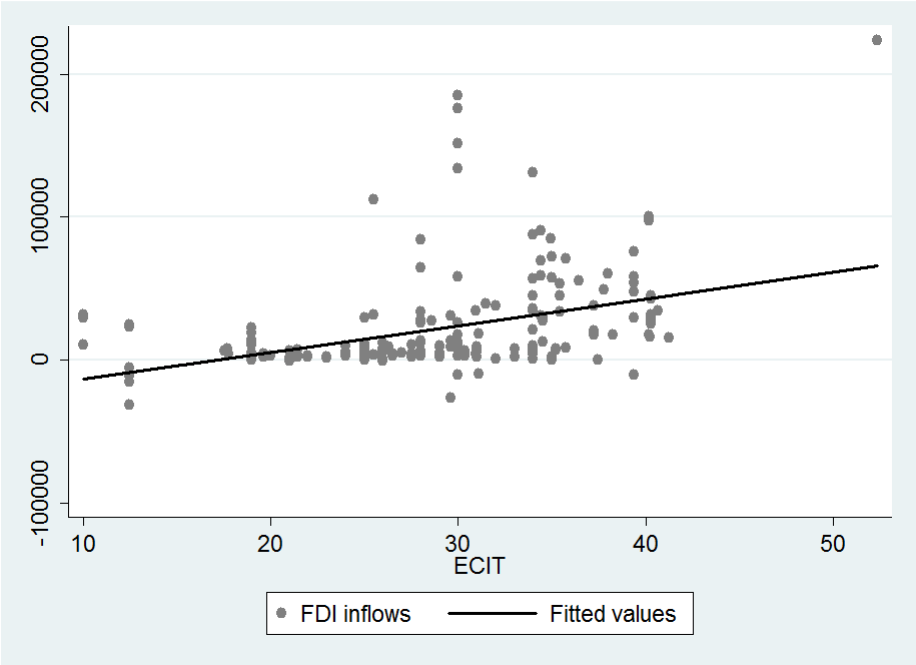

Figure 2.3 FDI Inflows vs. CITR for EU21

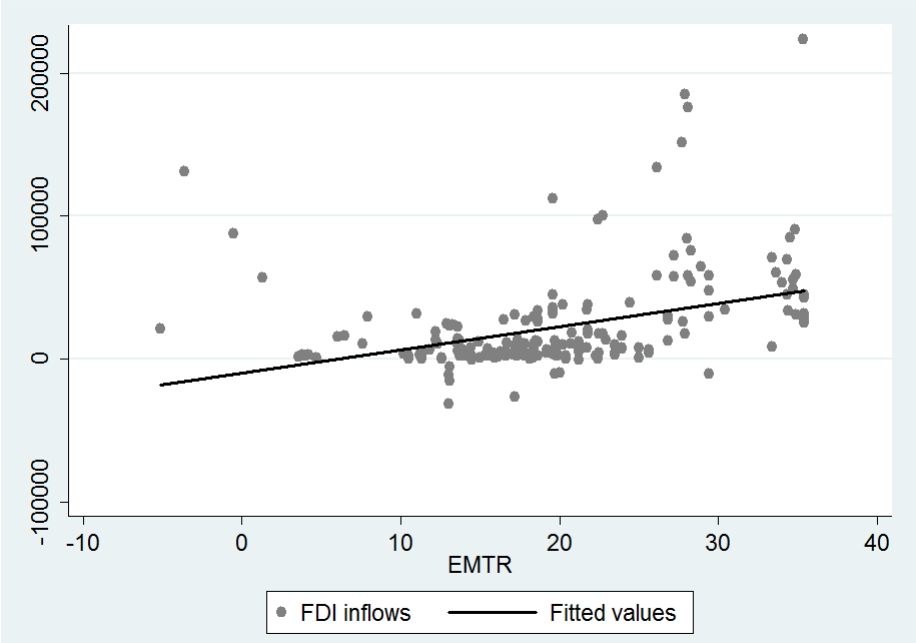

Figure 2.4 FDI Inflows vs. EMTR for EU21

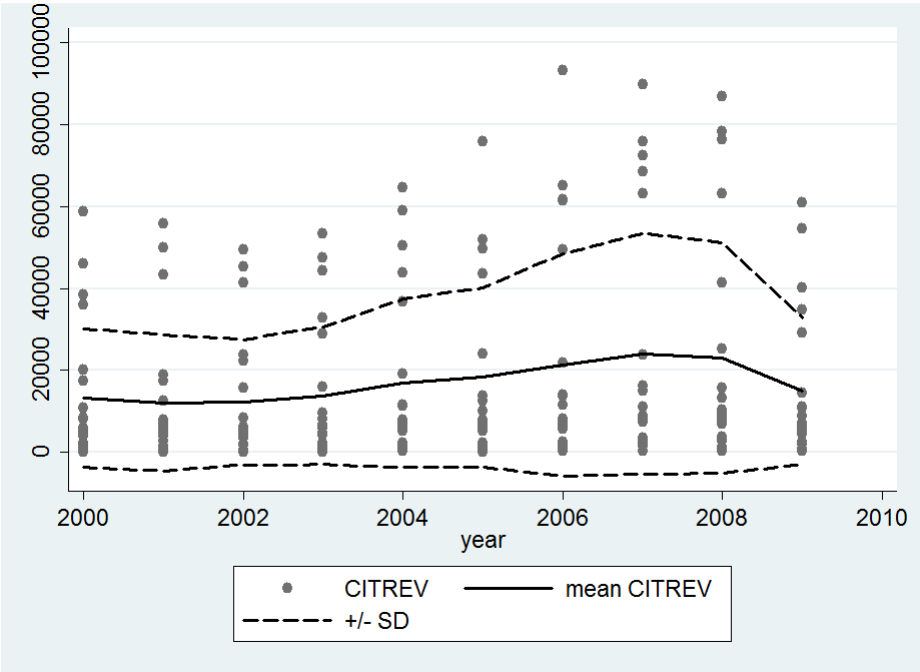

Figure 2.5 Revenue from Corporate Income Tax for EU21

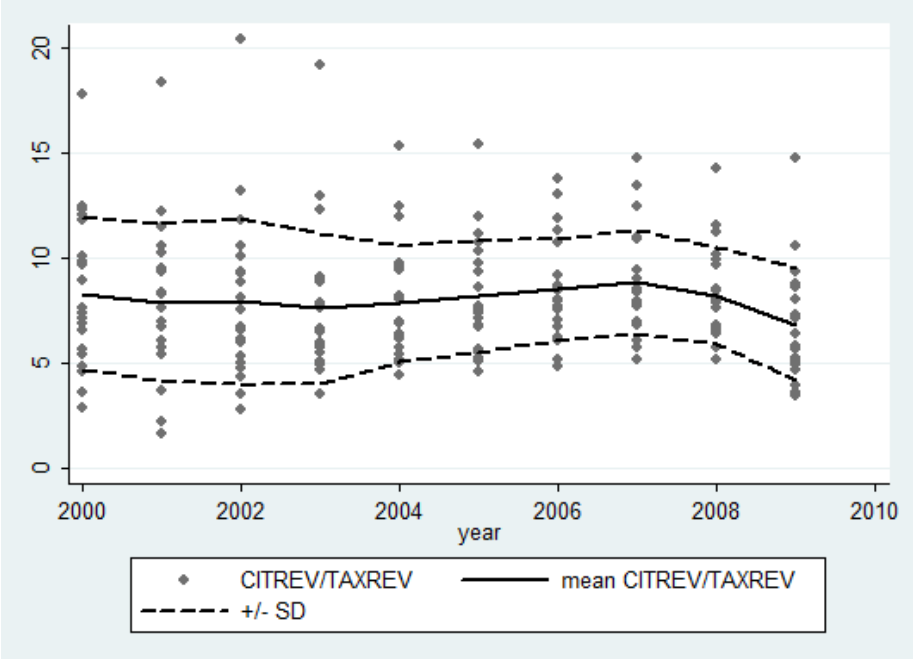

Figure 2.6 The ratio of capital income tax to total tax revenue for EU21

2-B Tables

Table 2.1 Estimates of Equation (2.10)

(the dependent Variable is T_{it}, the statutory capital income tax rate, CITR)
Sample is EU15 countries over 2000-2009 period

Regressors	Excluding Cross Tax Effect			Including Cross Tax Effect		
	Weighting Scheme 1	Weighting Scheme 2	Weighting Scheme 3	Weighting Scheme 1	Weighting Scheme 2	Weighting Scheme 3
CITR : $\overline{T}_{it}$	5.037	4.137**	1.403	4.814	3.869**	1.681
EMTR : $\overline{E}_{it}$	--	--	--	-0.054	-0.099	0.975*
$P_{it} \cdot \overline{T}_{it}$	-0.090	-0.066**	-0.035	-0.083	-0.063**	-0.054
PITR : P_{it}	2.487	2.146**	0.877	2.286	1.982*	1.602
$\ln GDP_{it-1}$	13.85	10.06	2.499	12.11	9.007	10.30
$\ln POP_{it-1}$	43.82	41.30**	28.24*	41.84	40.32**	54.60**
$\frac{CITREV_{it-1}}{TAXREV_{it-1}}$	-0.030	0.248	0.103	-0.029	0.254	0.516*
$\frac{DEBT_{it-1}}{GDP_{it-1}}$	0.066	-0.026	-0.004	0.056	-0.037	0.051
$\frac{GOV_{it-1}}{GDP_{it-1}}$	0.021	-0.059	-0.071	0.017	-0.091	-0.112
$\frac{POPDEP_{it-1}}{POP_{it-1}}$	-3.041***	-2.301***	-2.546***	-3.047***	-2.255***	-2.581***
R^2	0.527	0.518	0.653	0.542	0.539	0.476
AIC	577.01	593.57	548.95	574.57	589.61	606.72
BIC	606.07	642.96	598.34	606.53	641.91	659.01
LM	1.198 (0.977)	20.05 (0.003)	13.37 (0.038)	1.113 (0.953)	14.76 (0.011)	9.488 (0.091)
Wald	0.151 (16.88)	2.808 (16.88)	1.755 (16.88)	0.140 (13.95)	1.964 (13.95)	1.202 (13.95)
Sargan	0.983 (0.964)	5.683 (0.338)	11.02 (0.051)	0.990 (0.911)	5.748 (0.219)	4.328 (0.363)

- Number of observations = 135 and the estimation method is 2SLS (see the above explanations for choice of instruments).
- Fixed effects and trend coefficients are not reported.
- Weighting Scheme 1, 2 and 3 respectively use the Uniform, Distance-Based, and Competition-Based weights explained above. The Scheme 1 specification includes country-specific time trend instead of common time fixed effects.
- ***, ** and * denote statistical significance at 1%, 5% and 10% critical level based on heteroscedasticity-consistent standard errors (not reported).
- AIC is the Akaike information criterion.
- BIC is the Bayesian information criterion.
- LM is Anderson's canonical correlation LM test statistic of under-identification (p-values in parenthesis).
- Wald is the Cragg-donald's Wald F statistics test of weak identification (Stock-Yoko weak ID test critical value : 5% maximal IV relative bias in parenthesis).
- Sargan is the value of Sargan's over-identification test statistic (p-values in parenthesis).

Table 2.2 Estimates of Equation (2.11)

(the dependent Variable is E_{it}, the effective marginal tax rate, EMTR)
Sample is EU15 countries over 2000-2009 period

Regressors	Excluding Cross Tax Effect			Including Cross Tax Effect		
	Weighting Scheme 1	Weighting Scheme 2	Weighting Scheme 3	Weighting Scheme 1	Weighting Scheme 2	Weighting Scheme 3
CITR : $\bar{T}_{it}$	--	--	--	0.300	0.286	-0.193
EMTR : $\bar{E}_{it}$	-0.077	-2.520*	2.092	-0.025	-2.367	2.580
$P_{it} \cdot \bar{E}_{it}$	0.036	0.061*	-0.038	0.033	0.058	-0.047
PITR : P_{it}	-1.558	-2.225**	0.093	-1.498	-2.077*	0.328
$\ln GDP_{it-1}$	19.061	5.242	29.295	19.868	6.257	33.378
$\ln POP_{it-1}$	52.392	53.374**	69.938**	52.799	55.831*	74.978*
$\frac{CITREV_{it-1}}{TAXREV_{it-1}}$	0.412	0.497	0.436	0.415	0.538	0.464
$\frac{DEBT_{it-1}}{GDP_{it-1}}$	0.159	0.118	0.223**	0.159	0.116	0.240*
$\frac{GOV_{it-1}}{GDP_{it-1}}$	0.070	0.016	0.090	0.071	0.023	0.097
$\frac{POPDEP_{it-1}}{POP_{it-1}}$	1.604	2.118*	0.958	1.545	2.159*	1.032
R^2	0.190	0.333	0.133	0.188	0.332	0.103
AIC	734.01	721.69	755.12	736.24	723.85	763.62
BIC	763.06	771.08	806.51	768.20	776.15	815.92
LM	1.984 (0.921)	37.299 (0.000)	10.503 (0.105)	1.981 (0.852)	18.43 (0.003)	9.866 (0.079)
Wald	0.252 (16.88)	6.314 (16.88)	1.343 (16.88)	0.252 (13.95)	2.541 (13.95)	1.254 (13.95)
Sargan	0.824 (0.975)	22.709 (0.000)	1.935 (0.858)	0.778 (0.941)	22.629 (0.000)	1.821 (0.789)

– See the notes for Table 2.1.

Table 2.3 Estimates of Equation (2.10)

(the dependent Variable is T_{it}, the statutory capital income tax rate, CITR)
Sample is EU21 countries over 2000-2009 period

Regressors	Excluding Cross Tax Effect			Including Cross Tax Effect		
	Weighting Scheme 1	Weighting Scheme 2	Weighting Scheme 3	Weighting Scheme 1	Weighting Scheme 2	Weighting Scheme 3
CITR : $\bar{T}_{it}$	7.966***	3.397***	1.587	7.919***	3.366***	1.032
EMTR : $\bar{E}_{it}$	--	--	--	0.066	0.211	1.032**
$P_{it} \cdot \bar{T}_{it}$	-0.151***	-0.058***	-0.035	-0.151***	-0.059***	-0.035
PITR : P_{it}	4.429***	1.573***	0.992	4.421***	1.627***	1.051
$\ln GDP_{it-1}$	19.457***	4.355	1.748	19.679***	4.086	2.488
$\ln POP_{it-1}$	93.910***	42.090***	36.290**	94.265***	44.118***	48.230***
$\frac{CITREV_{it-1}}{TAXREV_{it-1}}$	-0.124	0.109	0.050	-0.116	0.063	0.294
$\frac{DEBT_{it-1}}{GDP_{it-1}}$	0.064	-0.017	-0.017	0.065	0.001	0.188
$\frac{GOV_{it-1}}{GDP_{it-1}}$	0.126	0.073	0.125	0.127	0.113	0.128
$\frac{POPDEP_{it-1}}{POP_{it-1}}$	-1.694***	-1.459***	-1.138**	-1.669***	-1.646***	-1.129**
R^2	0.343	0.556	0.555	0.342	0.551	0.504
AIC	872.42	812.40	812.70	874.65	816.49	835.26
BIC	904.83	867.51	867.81	910.31	874.84	893.61
LM	45.674 (0.000)	61.151 (0.000)	29.731 (0.005)	45.669 (0.000)	57.017 (0.000)	29.061 (0.004)
Wald	3.894 (19.83)	5.682 (19.83)	2.135 (19.83)	3.893 (18.47)	5.101 (18.47)	2.077 (18.47)
Sargan	7.044 (0.854)	24.790 (0.015)	15.132 (0.234)	7.015 (0.798)	23.119 (0.017)	8.334 (0.683)

– See the notes for Table 2.1, except noting that the number of observations now is 189.

Table 2.4 Estimates of Equation (2.11)

(The dependent Variable is E_{it}, the effective marginal tax rate, EMTR)
Sample is EU21 countries over 2000-2009 period

	Excluding Cross Tax Effect			Including Cross Tax Effect		
Regressors	Weighting Scheme 1	Weighting Scheme 2	Weighting Scheme 3	Weighting Scheme 1	Weighting Scheme 2	Weighting Scheme 3
CITR : $\bar{T}_{it}$	--	--	--	-0.104	-0.093	0.008
EMTR : $\bar{E}_{it}$	3.675	-3.662***	0.572	3.638	-3.732***	0.566
$P_{it} \cdot \bar{E}_{it}$	-0.050	0.092***	0.004	-0.049	0.094***	0.005
PITR : P_{it}	0.487	-2.342***	-0.585	0.460	-2.371***	-0.586
$\ln GDP_{it-1}$	25.969***	11.040	17.214*	25.809***	11.036	17.167
$\ln POP_{it-1}$	78.182***	34.148	67.051***	77.909***	33.941	66.969***
$\frac{CITREV_{it-1}}{TAXREV_{it-1}}$	0.335	0.800***	0.622*	0.337	0.794***	0.621*
$\frac{DEBT_{it-1}}{GDP_{it-1}}$	0.153**	0.107	0.136**	0.153**	0.107	0.135*
$\frac{GOV_{it-1}}{GDP_{it-1}}$	0.109	0.126	0.096	0.104	0.132	0.095
$\frac{POPDEP_{it-1}}{POP_{it-1}}$	1.581*	2.461***	1.741**	1.599*	2.482***	1.739**
R^2	0.125	0.288	0.192	0.127	0.284	0.193
AIC	995.15	970.32	994.10	996.62	973.18	996.01
BIC	1027.57	1025.43	1049.21	1032.28	1031.53	1054.36
LM	47.052 (0.000)	36.501 (0.001)	29.886 (0.005)	45.29 (0.000)	35.185 (0.000)	29.698 (0.003)
Wald	4.057 (19.83)	2.756 (19.83)	2.148 (19.83)	3.849 (18.47)	2.630 (18.47)	2.132 (18.47)
Sargan	5.746 (0.928)	14.012 (0.300)	4.843 (0.963)	5.754 (0.889)	13.915 (0.238)	4.845 (0.938)

– See the notes for Table 2.1, except noting that the number of observations now is 189.

Table 2.5 Estimates of the Modified Version of Equation (2.10)

(the dependent Variable is T_{it}, the statutory capital income tax rate, CITR)
Sample is EU21 countries over 2000-2009 period

	Excluding Cross Tax Effect			Including Cross Tax Effect		
Regressors	Weighting Scheme 1	Weighting Scheme 2	Weighting Scheme 3	Weighting Scheme 1	Weighting Scheme 2	Weighting Scheme 3
CITR : $\bar{T}_{it}$	5.513	-2.080	3.523*	3.754	-3.023	2.394
$\bar{T}_{it}^{EU04}$	0.401	-0.206	-0.337	1.214	-0.234	-0.192
EMTR : $\bar{E}_{it}$	--	--	--	0.036	0.373	0.964**
$\bar{E}_{it}^{EU04}$	--	--	--	-0.794	-0.046	0.007
$P_{it} \cdot \bar{T}_{it}$	-0.101	0.065	-0.084*	-0.064	0.083	-0.069
$P_{it} \cdot \bar{T}_{it}^{EU04}$	-0.009	-0.025*	0.009	-0.017	-0.030	0.006
PITR : P_{it}	3.181	-1.313	2.224*	2.311	-1.719	1.898
$\ln GDP_{it-1}$	17.916**	6.565	2.769	16.143*	5.990	3.239
$\ln POP_{it-1}$	87.932***	50.564***	35.631**	88.221***	54.811***	48.424**
$\frac{CITREV_{it-1}}{TAXREV_{it-1}}$	-0.119	0.191	0.025	-0.134	0.108	0.264
$\frac{DEBT_{it-1}}{GDP_{it-1}}$	0.048	-0.035	0.014	0.047	-0.011	0.040
$\frac{GOV_{it-1}}{GDP_{it-1}}$	0.119	-0.059	0.161	0.098	-0.014	0.154
$\frac{POPDEP_{it-1}}{POP_{it-1}}$	-1.816***	-1.815***	-1.006*	-2.064***	-2.219***	-1.083*
R^2	0.335	0.401	0.502	0.266	0.332	0.484
AIC	878.79	871.478	837.72	901.12	897.42	848.81
BIC	917.69	933.071	899.32	946.58	965.50	916.89
LM	6.831 (0.813)	11.177 (0.429)	20.059 (0.045)	5.081 (0.827)	5.875 (0.752)	19.350 (0.022)
Wald	0.442 (--)	0.708 (--)	1.346 (--)	0.325 (--)	0.360 (--)	1.292 (--)
Sargan	6.318 (0.788)	10.717 (0.38)	11.917 (0.291)	5.074 (0.750)	7.103 (0.526)	7.361 (0.498)
χ^2	0.64 (0.727)	7.81 (0.020)	1.62 (0.444)	1.22 (0.7485)	8.45 (0.037)	0.65 (0.886)

- See the notes for Table 2.1, except noting that the number of observations now is 189.
- χ^2 is χ^2 test for the joint significance of the added variables relative to table 2.3.

Table 2.6 Estimates of the Modified Version of Equation (2.11)

(The dependent Variable is E_{it}, the effective marginal tax rate, EMTR)
Sample is EU21 countries over 2000-2009 period

	Excluding Cross Tax Effect			Including Cross Tax Effect		
Regressors	Weighting Scheme 1	Weighting Scheme 2	Weighting Scheme 3	Weighting Scheme 1	Weighting Scheme 2	Weighting Scheme 3
CITR : $\bar{T}_{it}$	--	--	--	0.171	-0.140	-0.056
$\bar{T}_{it}^{EU04}$	--	--	--	0.638	0.216	0.146
EMTR : $\bar{E}_{it}$	1.686	-2.008	1.869	-1.696	-2.310	2.731
$\bar{E}_{it}^{EU04}$	0.391	-0.138	-0.796	0.273	-0.029	-1.031
$P_{it} \cdot \bar{E}_{it}$	-0.005	0.047	-0.036	0.071	0.054	-0.059
$P_{it} \cdot \bar{E}_{it}^{EU04}$	-0.011	0.012	0.019	-0.035	0.009	0.023
PITR : P_{it}	-0.292	-1.530	-0.078	-1.441	-1.629	0.313
$\ln GDP_{it-1}$	25.739***	14.980*	16.796*	24.472**	15.168*	17.727*
$\ln POP_{it-1}$	78.944***	38.018*	51.540*	80.199***	39.077*	54.496*
$\frac{CITREV_{it-1}}{TAXREV_{it-1}}$	0.396	0.863***	0.455	0.392	0.867***	0.369
$\frac{DEBT_{it-1}}{GDP_{it-1}}$	0.143*	0.129*	0.123*	0.140*	0.131**	0.134*
$\frac{GOV_{it-1}}{GDP_{it-1}}$	0.043	0.132	0.130	0.006	0.151	0.161
$\frac{POPDEP_{it-1}}{POP_{it-1}}$	1.716**	2.637***	2.150**	1.350	2.707***	2.086**
R^2	0.124	0.339	0.251	0.027	0.335	0.239
AIC	999.37	960.08	983.66	1023.23	965.32	990.82
BIC	1038.27	1021.68	1045.256	1068.62	1033.40	1058.90
LM	3.981 (0.971)	13.803 (0.244)	18.707 (0.067)	2.926 (0.967)	11.123 (0.267)	15.209 (0.085)
Wald	0.253 (--)	0.889 (--)	1.244 (--)	0.185 (--)	0.704 (--)	0.988 (--)
Sargan	5.174 (0.879)	13.389 (0.202)	3.977 (0.948)	3.980 (0.859)	13.021 (0.111)	3.381 (0.908)
χ^2	0.57 (0.754)	1.72 (0.423)	1.25 (0.535)	1.18 (0.758)	1.95 (0.582)	1.76 (0.624)

- See the notes for Table 2.1, except noting that the number of observations now is 189.
- χ^2 is χ^2 test for the joint significance of the added variables relative to table 2.4.

Table 2.7 The Impacts of Intergovernmental CITR and EMTR Competition on Countries Tax Rates

Sample is EU21 countries over 2000-2009 period

Country	$\overline{P}_i$	$\frac{\partial T_i}{\partial \overline{T}_i} = \hat{\phi}_T + \hat{\eta}_T \overline{P}_i$	$\frac{\partial E_i}{\partial \overline{E}_i} = \hat{\theta}_E + \hat{\eta}_E \overline{P}_i$
Austria	47.8239	0.7331984 (0.822481)	0.749232** (0.311211)
Belgium	55.9061	-0.489207 (0.859779)	1.494772*** (0.495997)
Czech Republic	31.8115	3.15502*** (0.946099)	-0.72783* (0.423066)
Germany	52.134	0.0813104 (0.833957)	1.146816*** (0.400603)
Denmark	41.6705	1.663879** (0.840575)	0.181614 (0.26274)
Estonia	38.7295	2.108696** (0.862974)	-0.08968 (0.286211)
Spain	40.3667	1.861075** (0.849462)	0.061343 (0.269545)
Finland	44.8238	1.186953 (0.826279)	0.472487* (0.272082)
France	49.662	0.455192 (0.824950)	0.918785*** (0.345747)
The UK	33.2084	2.943743*** (0.926219)	-0.59897 (0.389660)
Greece	35.9074	2.535529*** (0.892073)	-0.35 (0.331963)
Hungary	53.1536	-0.0729007 (0.839530)	1.240866*** (0.425270)
Ireland	29.9822	3.431695*** (0.974212)	-0.89657* (0.469377)
Italy	46.2851	0.9659367 (0.823218)	0.607284** (0.288001)
Luxembourg	34.8435	2.69644*** (0.904833)	-0.44814 (0.353425)
The Netherland	38.3292	2.16924** (0.866664)	-0.1266 (0.291512)
Poland	37.5534	2.286577*** (0.8742347)	-0.19817 (0.302999)
Portugal	37.2772	2.328351*** (0.8770616)	-0.22364 (0.307448)
The Slovak Republic	40.2405	1.880162** (0.850411)	0.049702 (0.270522)
Slovenia	45.0157	1.157929 (0.825747)	0.490188* (0.273790)
Sweden	47.2801	0.8154464 (0.822449)	0.69907** (0.302337)
Full Sample	42.0002	1.614013* (0.838599)	0.212025 (0.261999)

- The results are based on equation (2.10) and (2.11) reported in the third column of table 2.3 and 2.4.
- The numbers in parentheses below the estimates are the corresponding standard errors which can be used to test the restriction $\phi_T + \eta_T \overline{P}_i = 0$ and $\theta_E + \eta_E \overline{P}_i = 0$.
- ***, ** and * denote statistical significance at 1%, 5% and 10% critical level.

Chapter 3

Literature Review

3.1 Introduction

The proliferation of Preferential Trade Agreements (PTAs) has introduced a number of issues that affect several aspects of an economy. One of the most interesting aspects concerns the fact that PTAs can potentially attract investment into its member countries. It may also cause a relocation of industry between member countries. There is empirical evidence that the formation of PTA can attract FDI into the countries in the bloc − frequently at the expense of the excluded countries. Since the flows of FDI reflect a 'choice of location' and influence the location of investments and economic activities across countries. Given the potential of PTAs to affect the location choices of FDI, policy makers often believe that they can adopt policies to attract new firms or prevent existing firms from leaving the country. To the extent that PTAs may induce either the members or the excluded countries to opt for aggressive action – particularly by using taxation policies − then they may trigger intergovernmental competition for FDI. This view is supported by several empirical studies that find evidence of intergovernmental competition in both intra-regional and inter-regional levels.[5]

To survey and identify the theoretical linkages between intergovernmental competition, PTAs and location of industry, it is therefore convenient to structure the review along two strands of the existing literature, i.e.:(1) the effect of Preferential

[5] For example, Besley and Rosen (1998), Esteller-Moré and Solé-Ollé (2001), Goodspeed (2002, 2000) and Hayashi and Boadway (2001) investigate Stackelberg behaviour of the central government vis-a-vis a lower level governments within a country. Devereux, Lockwood and Redoano (2008) and Besley, Griffith and Klemm (2001) find a positively sloped reaction function for OECD countries. Overesch and Rincke (2011) find the evidence that of tax competition among European countries.

Trade Agreements on the location of industry, and (2) the effect of tax competition on the location of industry. However, prior to the review of these two strands of literature, it is useful to look atwhy vertical trade exists and its relationships with FDI.Then we look at the literature that focuses on the effect of Preferential Trade Agreements on the location of industry. Thereafter, we examine the literature on the effect of tax competition on the location of industry.

3.2 Foreign Direct Investment and Vertical Trade Patterns

In order to understandwhy vertical trade exists and its relationships with FDI, it is useful to start looking at some literature on organization economics. Antràs and Rossi-Hansberg (2009)provide an excellent review of the theoretical literature that focuses on the relationships between FDI strategies and vertical trade patterns. In particular, they review the literature that incorporates organization theories into general equilibrium trade models, focussing on the organizational problem concerning the decision of which transactions are to be carried out within the firm or across firms. We follow Antràs and Rossi-Hansberg (2009) in classifying research in this field into three approaches: (1) transaction costs, (2) fragmentation of production, and (3) matching and factor heterogeneity. Due to our particular interest in the relationships between FDI strategies and vertical trade patterns, we shall focus only on the literature that falls in the first two categories.

The first approach is based on the assumption that the incomplete nature of contracts governing international transactions limits the extent to which the production process can be fragmented across borders. Contractual incompleteness then creates frictions that affect organizational choices by firms, and hence influence the mapping between inputs and outputs differentially across countries. Therefore,

contractual frictions can shape the location of production and the structure of trade flows even in a model without any fragmentation of production. In their seminal paper, Grossman and Hart (1986) – who adopt the transaction cost approach of Coase (1937), Klein, Crawford and Alchian (1978) and Williamson (1979)–study the role of transaction costs, asset specificity, and incomplete contracts on the firm's choice of whether to perform the tasks in-house or to obtain the products of those tasks from outside via contractual relationships with unaffiliated suppliers. They argued that when the cost to write a complete contingent contract is too high, then it is optimal for the firm to vertically integrate – i.e. to purchase the assets of the supplier for the purpose of acquiring the residual rights of control. They argued that integration is optimal when one firm's investment decision is particularly important relative to the supplier's, whereas non-integration – which implies the presence of vertical trade – is desirable when both investment decisions are relatively important. Grossman and Helpman (2002) use alternative general equilibrium formalizations of the transaction cost approach to model a firm's decision to vertically integrate or outsource as a trade-off between the transaction that stems from search and incomplete contracts on the one hand, and the extra governance costs associated with vertical integration on the other. They suggest that – when markets are highly competitive – firm chooses to outsource if the per-unit cost of integrated firms is sufficiently large relative to that of specialized input producers. In contrast, the feasibility of outsourcing depends mostly on a comparison of the fixed costs of an integrated firm and those paid by specialized suppliers, if markets are not highly competitive. Vertical integration also potentially creates a negative externality on the remaining non-integrated bilateral relationships by thinning the market for inputs. Thus, the probability of finding a match decreases which, in turn, reduces the

attractiveness of outsourcing for the remaining non-integrated firms. Their result also implies that trade liberalization – which thickens the market for inputs, may lead toa worldwide disintegrated industrial system. Using the transaction cost approach, Antràs and Helpman (2008) study the firm's decision to choose between different ownership structures as well as suppliers' locations, while allowing for varying degrees of contractual frictions across inputs and countries as well as for firm with heterogeneous productivities. They argue that an improvement in contractual institutions in the South leads to the prevalence of offshoring, but it can reduce the relative prevalence of either FDI or offshore outsourcing if it disproportionately affects the contractibility of headquarter services (components). They also argued that the relative prevalence of alternative organization forms depends not only on cross-country differences in contractibility, but also on the degree to which contractual institutions are biased toward inputs controlled by the final-good producer or other suppliers.

The second approach is based on the model of international fragmentation of production across borders that arises because the production process can be broken down into small tasks. Then it becomes optimal for firms to fragment the production process in order to take advantage of cross-country differences in the cost of performing the necessary tasks, or producing the required intermediate inputs, as communication and trade costs reduce. These results can be found in Helpman (1984), Yi (2003) and Grossman and Rossi-Hansberg (2008). However, Markusen (1984) argues that – in the presence of increasing returns to scale – exporting may be more profitable because it provides the benefits associates with concentrating production in a single location. Additionally, Yeaple (2003a)develops a model that allows for the possibility of complex integration – which is a strategy of the

multinational enterprises (MNE) that concurrently undertakes horizontal integration and vertical integration. The reason is that these MNE establish affiliates in some foreign countries to reduce trade costs and establish affiliates in others to take advantage of factor price differentials. Yeaple (2003a) argues that vertical (horizontal) FDI dominates other strategies when the level of transport costs is low (high), whilst complex integration strategies dominate other strategies when the level of transport costs fall within an intermediate range.

In conclusion, the literature using the transaction costs approach mainly tries to explain the boundaries of multinational firms and enhance the understanding of trade and FDI flows. It generally predicts that the choice of firms to outsource is feasible if the cost of making contract with the outsiders is not too high. Firms that undertake outsourcing their tasks to outsiders, thus, are not going to undertake FDI. Therefore, the cost of contracts is the main factor that affects firm's FDI strategy. On the other hand, the literature using the fragmentation of production approach generally studies the role of trade costs in explaining the FDI strategy of multinational firms. However, the literature using this approach is not able to properly draw the boundaries of multinational firms. It suggests that firms undertake FDI whenever they can take advantage of the cross-country differences in factor endowments or technologies – with the existence of trade costs.

3.3 Preferential Trade Agreements and industry location

Before we proceed to survey the theoretical literature on Preferential Trade Agreements and industrial location, it is useful to start examining the effects of tariff policy on foreign investment. Blomstrom and Kokko (1997) point out that the early

theoretical literature on foreign investment tended to regard it as a substitute for trade. This view is based on the tariff-jumping argument, which implies that tariff barriers can motivate export-substituting FDI. Accordingly, general tariff reductions by a country would likely reduce FDI inflows into that country.[6] More recently, the literature has tried to capture the role of firm's intangible assets in determining FDI flows. These assets underpin Multinational Corporations' gains of a competitive edge over local firms in foreign markets. In order to exploit these assets, firms may need to 'internalize' their international operations by establishing foreign affiliates (Buckley and Casson, 1976, Dunning, 1977). This view tends to suggest that general tariff reductions would likely increase FDI. Regarding the tariff-jumping FDI argument, preferential trade liberalization would incentivize firms to produce in the home country and export to intra-regional markets rather than establish affiliates there. This would therefore decrease intra-regional horizontal FDI. However, to the extent that preferential trade liberalization would allow firms to operate more efficiently across international borders, it would – according to the internalization view – encourage firms to establish affiliates, thus incentivising intra-regional vertical FDI. This implies that countries with low initial trade barriers are more likely to benefit from increasing intra-regional FDI flows, because these countries are not likely to host tariff-jumping FDI that might be withdrawn when trade barriers decrease. However, these two views suggest that Preferential Trade Agreements would attract the inflows of FDI from outsiders into the region.

Carr, Markusen and Maskus (2001) use the Knowledge-Capital model of two countries, two homogenous factors and two homogenous goods to study the emergence of Multinational Corporations. One good is labour-intensive and is

[6] The interested reader is referred to Caves (1996) for a review.

produced under constant returns to scale in a fully competitive industry. The other is skilled-labour intensive and exhibits increasing returns to scale in a Cournot competitive market. They suggest that increasing trade costs would increase foreign investments, if the two countries are similar in size and relative endowments. On the other hand, increasing trade costs would reduce foreign investments, if the two countries are moderately different in relative endowment and the skilled-labour abundant country is somewhat smaller. Similar results can also be found in Markusen and Venavles (1998, 2000) and Markusen (2002).

Venables (1985) uses a model based on an oligopolistic competition framework and suggests that a unilateral increase in import barriers would induce firms to migrate to the country (to jump the higher tariffs), thereby reducing domestic prices (via a pro-competitive effect). He argues that a unilateral increase in import barrier policy would likely be welfare improving. This effect is also known as the 'price-lowering effect of protection', which is also shown by Venables (1987), Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud (2003) and Bagwell and Staiger (2009) within monopolistically competitive frameworks.

Regarding the theoretical literature on Preferential Trade Agreements, a key question generally raised is whether the formation of a PTA makes member countries better off. This strand of research can be traced back to the seminal work of Viner (1950), who argues that a PTA does not necessarily make member-countries better-off. This is the case if the change in consumer prices within the bloc is not sufficiently large to outweigh the costs from the inefficiency arising from a trade diversion effect. Freund and Ornelas (2010) provide an excellent review on a wide range of issues concerning the formation of PTAs. In this study, we are interested in two particular issues, i.e. 1) the effects of a PTA formation on the change of welfare

and 2) the effects of PTA formation on tariffs adjustment. Hence, we shall focus in particular on the literature related to these.

According to their review, Kemp and Wan (1976) show that a Customs Union (CU) is necessarily welfare improving, if the ex-post external tariffs are adjusted such that the formation of a CU does not affect trade with the excluded countries. To do so, such tariffs would keep external trade constant. Therefore, any additional trade between members must be the result of trade creation. Additionally, the excluded countries are not made worse off by the formation of a CU. It is also possible to make members and the excluded countries better off by the formation of Customs Union by using appropriate lump-sum transfers. These results extend to the case of Free Trade Agreements (FTA) (Panagariya and Krishna, 2002), partial liberalization (Neary, 1998) and imperfect competition (Mrazova, 2009). However, the Kemp-Wan result is impractical, since external tariffs are subject to political constraints and are not set to hold trade with outsiders fixed.

As pointed out by Freund and Ornelas review of the impact of PTA on external tariffs, Kennan and Riezman (1990) show that equilibrium external tariffs are higher under CU than those under FTA. They use a three-country general equilibrium model, in which tariffs are set to maximize social welfare, to simulate different scenarios to study the effects of forming a FTA as well as a CU. Krugman (1991b) shows − in multi-country model frameworks −that as the size of CUs increases symmetrically and the number of agreements decreases, the optimal tariff of each bloc will rise. In this scenario, world welfare is at the minimum if the number of agreements falls to three. Bond and Syropoulos (1996) show that the optimal tariff can either rise or fall as the number of CUs declines.

However, the impact on optimal tariff adjustments is different in the case of a FTA formation. This is because in this case governments are free to choose the level of external tariffs.Richardson (1993) argues that external tariffs tend to fall after the formation of a FTA, if that FTA results in a costly trade diversion. In this case governments have an incentive to lower external tariff rates which in turn motivate firms to increase imports from the excluded countries. Additionally, Bagwell and Staiger (1999) show that the role of terms-of–trade in inducing the governments of member countries to lower their external tariffs in the case of FTA formation and call this 'tariff complementarity effect'.

Regarding the theoretical literature on Preferential Trade Agreements and industrial location, Puga and Venables (1997) were among the first to allow for agglomeration forces in investigating the location effects of such agreements. They use a multi-country core-periphery vertical linkage (CPVL) model – which is one variant of the New Economic Geography models.[7] They assume that each country has two sectors. Country *r* is endowed with L_r units of labour, which is the sole primary factor of production. The two sectors are commodity (*A*) and industry (*M*). The *A* sector is perfectly competitive and produces a single homogeneous good with a constant returns to scale technology. The *M* sector is imperfectly competitive and produces a large variety of differentiated industrial goods with an increasing returns to scale technology. Firms in the industrial sector are assumed to be of the Dixit-Stiglitz's monopolistically competitive type (Dixit and Stiglitz, 1977). A fixed (α) and a variable (βx_r^S) quantities of a composite of labour and an aggregate of

[7] One interesting class of NEG model is the so-called 'vertical linkage' model (VL). In NEG models, agglomeration is generally a result of migration. However, inter-regional migration is not always a reasonable assumption. This observation encouraged the development of an alternative agglomeration mechanism based on vertical linkages between firms in each country. The vertical linkages mechanism was first introduced by Krugman and Venables (1995) and Venables (1996a). In this class of model, agglomeration of firms in the core country is triggered by the presence of input-output linkages, rather than inter-regional labour mobility.

industrial goods are required in the production of a quantity $x_r^S(i)$ of any variety *i* of industrial goods in any country *r*. The cost function of a firm producing variety *i* in country *r* is:

$$C_{M,r}(i) = P_{M,r}^{\mu} w_r^{1-\mu} \left(\alpha + \beta x_r^S(i)\right) \tag{3.1}$$

and the price index of the aggregate is:

$$P_{M,r} = \left(\int_0^{n^w} \left(\tau_{s,r} p_s(i)\right)^{1-\sigma} di \right)^{1/(1-\sigma)} \tag{3.2}$$

where w_r is the wage, $p_s(i)$ is the local price of individual varieties in country *s* and $\sigma > 1$ is the elasticity of substitution between varieties. The existence of iceberg trade cost $\tau_{s,r}$ implies that $\tau_{s,r}$ units of the good have to be shipped from country *s* for one unit to arrive in country *r*.

The typical consumer in each region has Cobb-Douglas preferences over the commodity and a CES aggregate of the industrial goods:

$$U_r = A_r^{\mu} M_r^{1-\mu}, \quad M_r = \left(\int_{i=0}^{n^w} m_{s,r}(i)^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}} \tag{3.3}$$

where *M* and *A* are consumption of the composite of *M* varieties and consumption of the *A* commodity respectively; n^w is the mass of *M* varieties consumed and $m_{s,r}(i)$ is the amount of variety *i* consumed.

Industrial firms are assumed to use the differentiated goods as intermediate inputs of production, in a basket defined by the same CES aggregator as the typical consumer. In particular, it is assumed that each firm supplies its product both to other firms (as an intermediate input) and consumer (as a final good). Therefore, the total

demand of variety *i* in country *r* produced by a firm in country *s* comprises of demand for consumers and intermediates by firms:

$$x_{s,r}(i) = m_{s,r}(i) + n_r z_{s,r}(i) \tag{3.4}$$

where n_r is the number of firms in country *r*, $z_{s,r}(i)$ is the amount of variety *i* produced in country *s* used as an intermediate to produce in country *r*. $x_{s,r}(i)$ is the total demand of domestically produced variety *i* in country *r*, where $r = s$. $x_{s,r}(i)$ is the total demand of imported variety *i* in country *r*, where $r \neq s$. Therefore, the total demand of variety *i* produced by a firm in country *r* is:

$$x_{s,r}(i) = p_r(i)^{-\sigma} \left(\frac{\tau_{s,r}}{P_{M,r}} \right)^{1-\sigma} \left[\mu Y_r + \gamma \int_{j \in n_r} C_r(j)\, dj \right] \tag{3.5}$$

where the term in square brackets is the sum of expenditures of consumers and firms on industrial goods.

Regarding labour market, the demand of labour in the commodity sector is perfectly elastic at wage equal 1. However, market clearing wages can be higher than unity only in those countries that specialized in the production of industrial goods. Therefore, equilibrium wage can be shown to be:

$$w_r = \max \left\{ 1,\ P_{M,r} \left[\frac{(1-\gamma) n_r \alpha \sigma}{L_r} \right]^{1/\gamma} \right\} \tag{3.6}$$

In this model, there are four forces that determine the equilibrium distribution of firms across locations, namely product market competition, labour market competition, forward linkages and backward linkages. Product market competition is stronger in the country in which more goods are produced locally. Product market

competition will work towards lowering the industrial goods price index (3.2), for a given price and level of expenditure. Consequently, local demand for each good (3.5) becomes smaller. Labour market competition in the country that specialises in industrial production will cause local wages (3.6) to increase. This, in turn, would increase the total cost of production. The first two forces cause firms operating in a market with a higher degree of competition to have less profit. Hence those two forces generally encourage the dispersion of industry. On the other hand, forward linkages work towards a lowering of the price index in (3.2), simultaneously lowering the total and marginal costs of production in (3.1). Finally, backward linkages arise as increasing number of firms in the local market raise local expenditures and demand on intermediates (3.5). Thus, the last two forces tend to increase firms' profit by operating in a market with a relatively larger number of firms. Therefore, these two forces attract firms to agglomerate in one location.

With respect to a general tariff reduction, Puga and Venables (1997) show that the symmetric equilibrium is stable, if the values of trade barriers are higher than a critical value, which is given by:

$$\tau^* = \left(1 + \frac{M\gamma(2\sigma - 1)}{(1-\sigma)\left[\sigma(1-\gamma) - 1\right]}\right)^{1/(\sigma-1)} \tag{3.7}$$

where M is the number of countries. However, the symmetric equilibrium becomes saddle point unstable if trade barriers fall below the critical value. As a result, there are multiple asymmetric equilibria, where industrial firms agglomerate in some countries and the commodity is produced in others.

Puga and Venables (1997) show that a PTA formation results in production shifting, in which firms in the excluded countries relocate into PTA member

countries, if the values of intra-trade barriers are higher than the critical value.[8] However, if the values of intra-trade barriers are lower than the critical value, there is a relocation of firms within the PTA area, which results in an agglomeration of firms in one of the member countries. However, the movement of firms in the excluded countries is ambiguous. This result has been generalized and is referred to as the 'two-tier home market effect' by Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud (2003). Puga and Venables (1997) suggest that firms tend to agglomerate in a country, which acts as a 'hub', because firms operating in 'spoke' countries are made worse off by a lower demand by both consumers and firms in other 'spokes' countries (these are referred to as the 'hub-and-spoke' effects of a PTA).

Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud (2003) use a multi-country 'footloose-capital vertical linkage' model (FCVL) model to investigate the impact of PTAs on industrial location.[9] They show that – in a three-country version of the model − firms from the excluded country gradually relocate to PTA countries, as intra-PTA trade barriers start decreasing. At this point, firms are evenly spread between both member countries. However, the internal catastrophe, or two-tier home market effect, occurs if intra-PTA trade barriers are lower than a critical value. There is a sudden rise of firms in one member country – which makes this country become the core region − and a discrete fall of firms in another. The impact on firms in the excluded country is ambiguous. As intra-PTA trade barriers keep decreasing below the critical value, firms in the excluded country migrate and agglomerate in the core country within the PTA area until no firm is left in the excluded country.

[8] The 'production shifting' effect was first suggested by Baldwin and Venables (1995).

[9]The footloose-capital vertical linkage (FCVL) model was proposed by Robert-Nicoud (2006, 2002), as an extension of the FC model. Like the FC model, the FCVL model has two primary factors(labour and capital) with the latter being inter-regionally mobile. There are two sectors and two countries. Capital owners allocate their capital so as to maximize nominal return and spend their income locally. In the FC model, inter-regional mobility of capital alone is not sufficient to create agglomeration. However, in the FCVL model, which adds input-output linkages, displays self-enforcing agglomeration forces.

Most of the theoretical literature focuses on the merit of PTA membership of the integrating countries. However, the impact of PTA on non-member countries has also been examined, as in Pomfret (1997) and Bhagwati, Krishna and Panagariya (1999). The result is that a PTA typically causes non-member countries to be made worse-off.

3.4 Tax competition and industry location

The increasing mobility of capital and the reductions in trade costs that have accompanied economic integration also give rise to incentives for countries to compete over mobile capital as investors have gained greater freedom to take advantage of and have developed a greater sensitivity to foreign economic opportunities. The intrinsically more footloose nature of capital implies that decisions about the location of businesses have become more sensitive to tax factors. The prominent policy for many countries, in order to attract mobile capital, is the modifications of tax rates. Such changes in taxation policies aim to raise countries' attractiveness to investment and incentivize production and, in some case, also to remove existing tax distortion at the same time. This situation may give rise to intergovernmental tax competition. Regarding the theoretical literature on tax competition, there are two distinct approaches that researchers use to study this subject. The first one is known as 'Basic Tax Competition' Model (BTCM). The second is based on 'New Economic Geography' (NEG) model.

3.4.1 Basic Tax Competition Model Approach

The theoretical literature on tax competition in the BTCM strand can be traced back to Tiebout's theory of local public good provision, which states that the competition among jurisdictions for households leads to an efficient provision of local public

goods. In particular, households 'vote with their feet' by efficiently sorting themselves across jurisdictions and local governments respond by tailoring their taxes and expenditures to the preferences of their residents (Tiebout, 1956).

Tiebout applied this theory to competition between governments for mobile households, which tends to be welfare enhancing since it forces governments to be efficient. However, this can also be applied to competition for firms as suggested by Fischel (1975), White (1975) and Wellisch (2000). However, the Tiebout hypothesis has been widely criticised mostly because it relies on several restrictive assumptions.

Contrary to the Tiebout hypothesis, Oates (1972) argues that tax competition can result in inefficient levels of public services. In order to attract investment, local officials may have to lower taxes, which in turn may have to hold public spending below an efficient level. His view then becomes the dominant theme in the modern basic tax competition approach. However, it was not until the mid 1980s that the tax competition models based on his view have been formally constructed. Two of the earliest models were proposed by Zodrow and Mieszkowski (1986) and Wilson (1986), which became known as the Basic Tax Competition Model (BTCM). Based on the BTCM model by Krogstrup (2002), Baldwin and Krugman (2004) and Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud (2003) use two-region framework to show the results of BTCM. The two regions are North and South, with perfectly competitive firms producing a single output in each region. To produce that good, two factors of production are required: capital, *K* (a perfectly mobile factor), and labour, *L* (an immobile factor that is inelastically supplied by each region's residents). The North and South regions own an amount of mobile factors equal to K and K^* respectively and the world's fixed capital stock is $K + K^* = K^W$. The amount of the mobile factors employed in the North and South regions is n and n^*,

respectively. Note that n is not necessarily equal to K and n^* is not necessarily equal to K^*, but $n+n^*=K+K^*=K^w$. When the amount of world's fixed capital stock, K^w is normalized to unity, $n+n^*=K^w=1$. When capital is perfectly mobile, the spatial allocation of capital is determined by the equation:

$$F_K[n,L](1-t)=F_K[1-n,L^*](1-t^*) \tag{3.8}$$

where F_K is the return to capital, t and L are the north's tax rate and labour force, while t^* and L^* are the corresponding variables for the south.

In this model, the Northern government's problem is to set public good and tax rate in order to maximize the welfare of its representative resident, that is to maximize:

$$U\left[G,C\right];\ G=tY,\ C=\left(1-t\right)I \tag{3.9}$$

where *U* is the preferences of the northern typical consumers, *G* is the public good consumption, *C* is private consumption, *Y* is GDP and *I* is GNP. This reflects the fact that n is not necessarily equal to K, therefore $Y=F\left(n,L\right)$ and $I=F\left(n,L\right)-F_K n+F_K K$. The tax rate, t, is applied to all factor income generated inside the nations (source principle).[10] Thus, the government revenue is tax on $F_L L$ and $F_K n$, when capital is perfectly mobile.

The government's first order condition is:

[10] If capital is perfectly mobile, *K* and *n* may be different. Consequently, *Y* and *I* may be different. According to the source principle, the government will not tax the repatriated capital income of its citizens. Therefore, the government only levies the tax on GDP (while disposable income is after tax GNP).

$$\frac{U_G}{U_C} = \frac{-dC/dt}{dG/dt} \tag{3.10}$$

also $$\frac{-dC/dt}{dG/dt} = \frac{I}{Y\left(1+\frac{dn/n}{dt}t\eta\right)}; \quad \eta = \frac{n}{Y}F_K\left[n, L\right] \tag{3.11}$$

where $\eta > 0$ is the capital-output elasticity and dn/dt is the responsiveness of capital to northern taxes. The LHS of (3.10) is the marginal rate of substitution between the consumption of public and private good. . When capital is mobile, dn/dt is negative. This means that capital flows out of the region when the government raises its tax rate. So, the RHS of (3.10) exceeds unity. Thus, this implies that capital mobility causes capital tax rate to be too low from the social welfare perspective. There is a negative correlation between capital mobility and capital tax rate. So any policies that cause a slight uniform rise in capital tax rate in both countries are Pareto improving. Totally differentiating the location condition yields:

$$\frac{dn/n}{dt} = \frac{F_K / n}{\left(1-t\right)F_{KK} + \left(1-t^*\right)F^*_{KK}} < 0 \tag{3.12}$$

In the model, country size is measured by the supply of the immobile factor *L*. Asymmetries in size are then reflected in differences in labour force. Assume that the North has a relatively larger *L*, but both countries have identical relative factor endowments (i.e. $L > L^*$ but $K/L = K^*/L^*$). In this case, if taxes were equal, perfect capital mobility would equalize both countries' capital-labour ratios. This implies that there is no capital movement between the two countries. However, (3.11) shows that if taxes were equal, the North would have a lower $(dn/n)/dt$, since $n = K > n^* =$

K^*. This means that capital is less sensitive to changes in the tax rate in the larger country. Given this result, the government in the North would prefer to set a tax rate higher than the one used in the South, so as to allow some of its capital to move southward. Thus, in equilibrium, $t>t^*$ but $n/L < n^*/L^*$. Therefore, in this asymmetric case, the large country will typically have a higher tax rate than the small country. The large country should also have a lower capital-labour ratio. This implies that the small country should have higher per capita income. Given that the movement of capital causes n to decrease and $n^*$to increase, while L and L^* are unchanged, Southern per capita income n^*/L^*, is higher than Northern per capita income, n/L. In this instance, then, the large country is an exporter of capital, which means that capital flows from the poor to the rich country. Finally, the responsiveness of capital to the tax rate is predicted to be lower in the country with a larger share of the world supply of immobile factor. Similar results can be found in Bucovetsky (1991) and Wilson (1991).

Contrary to the previous BTCM results, different results are found in Haufler and Wooton (1999, 1997). They study tax competition between two countries with different size using an extension of the BTCM model. To do so, they incorporate trade costs and allow governments to use multiple tax instruments i.e. a profit tax (subsidy), and a consumption tax. They show that – in the presence of exogenous trade costs – both countries will always offer to subsidize firms, if a lump-sum profit tax is the only fiscal instrument available to governments. Additionally, a larger country would offer a higher subsidy than a smaller country. However, a larger country may impose a positive profit tax, if governments are given an additional instrument, either a tariff or a consumption tax. In both cases, firms choose to locate in a larger country in the equilibrium.

The standard BTCM model generally has only a single good and ignores international trade. Wilson (1987) adds a second good and incorporates an international trade aspect into a multi-regional tax competition analysis. In equilibrium, regions choose to either impose a low tax rate on capital and produce only the capital-intensive good or impose a high tax rate on capital and produce the labour-intensive good. No region produces both goods, because a slight reduction of tax rate would eliminate all production of the labour-intensive good, and transforms region into producers of the capital-intensive goods. Based on this framework, Janeba and Wilson (1999) look at whether tax competition over mobile capital causes capital tax rates to be too low or too high. They argue that whether capital tax rates are too low or too high depends on the degree of external trade protection. Tax competition leads to inefficiently low capital tax rates, if government is free to set a tariff. However, such tax rates can be too high in the absence of a tariff.

Davies and Eckel (2010) incorporate recent innovations from the literature on trade and foreign direct investment into a tax competition framework by modelling governments' competition for heterogeneous, imperfectly competitive firms with endogenous entry.[11] They construct a model of two countries with different size of labour endowment. A representative consumer derives utility from private consumption of differentiated industrial goods − both domestically produced as well as imported goods − of the Dixit-Stiglitz form. They assume that trade costs are zero. Firms use labour as a sole factor of production. A firm requires a fixed amount of labour and an additional variable unit labour requirement for its production. They assume that firms different in their unit labour requirement, thus exhibiting different productivities. They suggest that the high productivity firms with high profit are

[11]The interested reader is referred to e.g.,Ghironi and Melitz (2005) and Melitz (2003) for example of trade models and to, e.g., Nocke and Yeaple (2008), Helpman, Melitz and Yeaple (2004) and Yeaple (2003b), for examples in the FDI literature. .

attracted by low-tax countries even though they have to pay for high cost of labour, while the low productivity firms with low profit margin choose to locate in the low labour cost country even though they have to pay a higher tax rate. Additionally, they argue that not only does tax competition lead to the under-provision of public good, but it can also encourage excessive firm entry. As a result, they suggest that intergovernmental tax coordination can improve welfare.

Generally, the results emerging from the BTCM model show that perfect capital mobility leads to inefficiently low levels of tax rates and results in too low levels of public goods provision. Burbidge and Cuff (2005) and Fernandez (2005) uses the BTCM model with augmented agglomeration forces. Burbidge and Cuff (2005) allow for increasing returns to scale on both firms and the aggregate level, while Fernandez (2005) adds external economies of scale to the standard model. They find results that are compatible with those of the standard BTCM. Additionally, they suggest that tax competition becomes fiercer when agglomeration forces are included. However, Krogstrup (2008) − who uses a standard BTCM model a la Zodrow and Mieszkowski (1986) augmented with external economies of scale following Fernandez (2005) − argues that the model based on the BTCM can generate the result of too high a level of tax rates from a social optimum point of view, if agglomeration forces are sufficiently high. He assumes that countries are identical, governments can raise revenues through imposing a capital tax and a lump-sum head tax, and all capital initially agglomerates in the core region. He argues that the core government will choose to raise its revenue from capital tax only. This is because the core government can shift half of the tax burden on to the capital owners in the peripheral region. On the other hand, the periphery government will finance it revenue via a lump-sum head tax only. The core will wish to set the highest possible

tax rate which does not trigger a relocation of capital, given the capital tax rate of the periphery. The periphery government's objective is to maximize the net capital income of its citizens, therefore the government will set its capital tax rate at zero − which is the rate that keeps the core capital income tax rate at its lowest. In this case, tax competition pressures are welfare improving, as they counteract the core government tendency to overtax.

Raff (2004) investigates the issues of how PTAs affects the location of FDI and social welfare, assuming that governments may adjust tax and external tariffs to compete for FDI. He uses a three-country model, in which two of them represent potential PTA members, while the other represents the excluded countries. He also assumes that a foreign investor with monopoly power will either choose a location of a plant in one or more of the potential member countries or locate a plant in the excluded countries and export to PTA countries. He finds that a Free Trade Agreement (FTA) may lead to FDI creation or consolidation. The FDI creation occurs if the production costs in the FTA member countries are in an intermediate range relative to those in the excluded countries. The joint welfare of member countries rises, if tax competition is not too strong. FTA may fail to attract FDI if the cost advantage of the FTA countries relative to that of the excluded countries is not sufficiently high. This is because there may be multiple equilibria and countries may fail to coordinate to achieve equilibrium with FDI – or the high-cost country may reduce its external tariff to induce firms to import from the excluded countries. In both cases a Customs Union (CU) is a dominant policy, in the sense that it can attract FDI and improve welfare. If an investor initially invests in both countries, the PTA will lead to FDI consolidation in the low cost member. The low cost country benefits from the FTA and is able to compensate the high cost country for its welfare loss, if

tax competition is low and the fixed cost of FDI is sufficiently large. He also concludes that tax competition will drive the level of profit tax down.

3.4.2 New Economic Geography and tax competition

The new economic geography (NEG) is a branch of economic studies that analyses the relationship between trade liberalization and industrial location, as set out in a series of seminal papers by Krugman (1991a), Krugman and Venables (1995) and Venables (1996a). The main features of most NEG models consist of increasing returns to scale, iceberg trade costs and monopolistic competition as modelled in the framework developed by Spence (1976) and Dixit and Stiglitz (1977). The use of NEG models to analyze tax competition issues gives rise to results that contrast the standard neo-classical framework of the BTCM. The different results arise from a key feature of NEG models, namely that industries display hysteresis in location (Baldwin, et al., 2003). This means that when industries have agglomerated in one country, they tend to get stuck there because of agglomeration forces. This implies that mobile factors would then not respond to marginal changes in tax rates, when agglomeration has occurred.

Ludema and Wooton (2000) were the first to use an NEG framework to analyze the effect of tax competition. Instead of using differentiated goods, monopolistic competition and iceberg trade costs as in the typical NEG model, they assume a homogeneous good, oligopoly and moving costs in their model. They also employ a quasi-linear utility function for representative consumers. They focus on the effect of integration, either in the form of decreasing trade costs or increasing labour mobility, on the intensity of tax competition. They show that decreasing trade costs reduces the intensity of tax competition. While increasing labour mobility has mixed effect. Moreover, they find that the only case in which economic integration

intensifies tax competition is when it takes the form of increased factor mobility in the symmetric case where industries spread between both countries.

Forslid (2005) uses the variation of NEG model developed by Martin and Rogers (1995), also known as the Footloose Capital (FC) Model, to analyze tax competition between two countries. The FC model is appealing because of its simplicity and analytical tractability. It displays agglomeration forces, even though it does not show circular causality, which characterizes other NEG models. This FC model assumes two countries, called *1* and *2*, two sectors, agriculture and manufacturing, and two factors, labour and capital. Capital owners are immobile between countries, but capital is perfectly mobile and all of its return will be sent back to the country where capital owners reside. Workers can move freely between sectors but are assumed to be immobile between countries. Country *r* is endowed with a share s_r of the world endowment of labour (L^W) and capital (K^W). The agricultural sector produces a homogeneous good (*A*) with a constant-returns technology, using labour as the only factor of production. The industrial sector produces a differentiated good (*M*) with an increasing-returns technology, using both capital and labour.

Each country imposes a tax rate on capital; t_r, $r \in 1,2$. Each government spends its tax revenues over the composite of *M* varieties and consumption of the *A* good with the same proportion as the representative consumer spend their income. As a result, the aggregate world expenditures are not affected by the size of the tax. The representative consumer in each country has preferences given by a two tier utility function, which is the same to the one shown in (3.3).

For trade under monopolistic competition, utility optimisation by consumers yields a standard CES demand function for each industrial variety in country *r*, namely

$$m_{s,r}(i) = \mu \frac{\left(\tau_{s,r} p_s(i)\right)^{-\sigma}}{P_{M,r}^{1-\sigma}} E_r \tag{3.13}$$

where E_r is total expenditures in country *r*. To produce the homogeneous good (*A*), a_A units of labour are required. Using good *A* as the numeraire and assuming a unit labour requirement of unity (i.e. $a_A = 1$), wages will be equal to one in both countries. To produce a typical differentiated good, a fixed cost in terms of capital is incurred as well as a variable cost that involves only labour. The cost function of a typical firm producing variety *i* in country *r*is then:

$$C_{M,r}(i) = \alpha\pi_r + \beta x_r^S(i) \tag{3.14}$$

where α is the fixed cost of capital, π is firm's operating profits, and β is the requirement of unskilled labour per unit $x_r^S(i)$.

The agricultural good is freely trade, but industrial goods trade is inhibited by iceberg trade costs, which imply that to sell one unit of industrial good in the other region, an industrial firm must export $\tau > 1$ units.

In the short run, the allocation of the mass of industrial firms is taken to be fixed. So, the operating profit of industrial firm in country *r* will be given by

$$\pi_r = \frac{\mu E_r}{\sigma\left(n_r + \phi n_s\right)} + \frac{\phi\mu E_s}{\sigma\left(\phi n_r + n_s\right)} \tag{3.15}$$

where E_r and E_s are total expenditures in country *r* and *s* respectively, n_r and n_s are the mass of manufacturing firms in country *r* and *s* respectively and $\phi \equiv \tau^{1-\sigma}$ is a parameter that captures the freeness of trade between two countries, ranging from 0 to 1. A country is considered to be an autarky, when ϕ equals to 0, whilst trade is completely free if ϕ equals to 1. In a typical NEG model, there are two types of long-run equilibria, i.e. interior equilibria (in which industries locate in both countries) and corner solutions (in which all of the industry ends up in only one country). When capital is fully mobile between countries, capital owners will seek an optimum net rate of return. So, the location condition for interior equilibria in this model is given by

$$(1-t_1)\pi_1 = (1-t_2)\pi_2 \tag{3.16}$$

where π_1 and π_2 are Country 1 and Country 2 firm's operating profit respectively. This location condition indicates that firms do not fully agglomerate in any country as long as the after tax operating profits from both countries are equal.

When the tax rate is zero in both countries, $t_1 = t_2 = 0$, the mass of industrial firms in country *r* is given by

$$n_r = \frac{1}{2} + \left(s_r - \frac{1}{2}\right)\frac{1+\phi}{1-\phi} \tag{3.16}$$

where s_r is the share of the world endowment of labour in country *r*. Thus, the mass of industrial firms in each country depends on its size and the level of trade costs. The mass of firms rises more than proportionally to s_r when $\phi > 0$ and the effect is very large when ϕ approaches 1. When countries are asymmetric, all industry

agglomerates in the larger country when $\phi=(1-s_r)/s_r$. The agglomeration rent, which is given by a relative operating profit π_1/π_2, is determined by the parameters μ and σ. A high μ means a high share of expenditures on the manufacturing good, which generates an incentive for industrial firms to agglomerate in the larger market. Instead, a low σ means a high market power for each industrial firm, which, in turn, means a higher price mark-up on marginal cost. Furthermore, agglomeration rents are hump-shaped in trade freeness, ϕ. When trade is highly restricted, agglomeration rents are low. At this level of trade freeness, import goods are very costly, thus consumers spend most of their income on locally produced good. In this case, if firms agglomerate in one country, firms will face a stronger competition that puts pressure on their operating profit. Then, agglomeration rents increase when trade freeness is at an intermediate level, which makes import less costly. At this level of trade freeness, agglomeration rents are sufficiently high, so that firms have an incentive to operate in the large market and export to the other. Finally, agglomeration rents fall again when trade are free. At low level of trade costs, consumers are relatively indifferent between locally produced goods and import goods. Therefore, firms do not have incentive to agglomerate in any country.

When countries impose the same tax rate, i.e. $t_1=t_2=t$, the location of industrial firms is given by

$$n_r=\frac{1}{2}+\left(s_r-\frac{1}{2}\right)\frac{tb-1}{tb-z} \tag{3.17}$$

where $b \equiv \mu/\sigma$ and $Z\equiv(1-\phi)/(1+\phi)$. Now b is a measure of agglomeration forces and Z is a measure of trade costs, where $0 \leq Z \leq 1$. Lowering trade costs will induce firms to move into the larger region. In the basic setting, there is neither demand-linked nor

cost-linked circular causality in the FC model. However, a positive tax introduces a new demand-link effect, which is the result of more firms operating in the larger country. This implies a larger tax revenue and hence a higher government's expenditure, because firms have incentive to operate in the larger market and export to the smaller one, when trade freeness is at intermediate level. As a result, a higher government's expenditure will additionally induce more firms to move to the country. The higher the level of tax rate *t*, the stronger is the effect. This effect is also increasing as trade cost is decreasing. Furthermore, all of the industrial firms will agglomerate in the larger country, when trade freeness ϕ is higher than $s_j\left(1-tb\right)/\left(1-s_j\left(1-tb\right)\right)$.

The effect of unilateral tax increase, evaluated at a zero tax, is given by

$$\left.\frac{dn_r}{dt_r}\right|_{t_1=t_2=0} = -\frac{\left(1-s_s\right)\left(1+\phi\right)\left[b\phi+s_r\left(1-b\right)\left(1+\phi\right)\right]}{\left(1-\phi\right)^2} < 0 \qquad (3.18)$$

When any country raises its tax rate unilaterally, it will lead to a loss of industry. The extent of this effect depends positively of the level of trade freeness. However, agglomeration forces will make firms less sensitive to the change in tax rate, if the share of the world capital stock, s_r, is sufficiently large.

Then, the effect of the size of the country on location is given by:

$$\left.\frac{d}{ds_r}\left(\frac{dn_r}{dt_r}\right)\right|_{t_1=t_2=0} = \frac{b\left(1+\phi\right)\phi+2\left(s_r-0.5\right)\left(1-b\right)\left(1+\phi\right)^2}{\left(1-\phi\right)^2} \qquad (3.19)$$

The effect of country's size is positive as long as $s_r > 1/2$, which means that the larger the size of the country the lesser is the elasticity of its capital stock with respect to tax rates.

Using the FC model, Forslid (2005) concludes that a high general tax level reinforces agglomeration forces, even if countries are symmetric. Firms will respond to unilateral marginal tax changes, when countries are symmetric. In the case that full agglomeration occurs in the core country, firms will benefit from agglomeration rents. Therefore, firms become quasi-immobile, in the sense that they are unresponsive to an increase in tax rate in the core country, as long as the difference in tax liabilities is less than the agglomeration rents. This means that the core country has some freedom to set its tax rates without any loss of industrial firms. Moreover, the elasticity of capital with respect to tax level is lower in the larger country because of agglomeration forces.

Baldwin and Krugman (2004) and Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud (2003) use the solvable NEG model variant of Krugman (1991a), as developed by Ottaviano (1996), Forslid (1999) and Forslid and Ottaviano (2003) − also known as the Footloose Entrepreneur (FE) Model − to analyze tax competition. This model uses the same assumptions as the FC model above, except for factor inputs – as it assumes that two factors are required to produce industrial goods. These two factors are “entrepreneurs” and “workers”. Entrepreneurs are internationally mobile, while workers are internationally immobile. To produce the homogeneous good, only workers are required. To produce manufacturing goods, one entrepreneur is required as a fixed cost and workers are required as variable cost. The paper focuses on tax competition between countries when industrial firms have already agglomerated in the core country. It suggests that agglomeration forces induce firms to operate close to each other in the core country. These forces imply that firms earn more in the core nation. This, in turn, allows government in the core country to tax their industry at a higher rate than the periphery as long as the gap is not too wide –

i.e. the core government can tax ‘locational rents’. Given that the core government will not let industry to relocate to the periphery, the core government will set its tax rate to be sufficiently low to make the periphery indifferent between having industry operate in its country or not. Then the periphery government can choose its tax rate unconstrained, that is without an intention to compete over industry. This equilibrium tax gap is bell-shaped. Starting from a low level of trade freeness, the tax gap increases as trade gets freer then decreases when trade costs approach zero. The bell-shaped links between trade costs and agglomeration rents also implies that integration leads to a bell-shaped core-periphery tax gap. Baldwin and Krugman (2004) also argue that policies that try to mitigate tax competition by imposing tax harmonization will harm at least one nation and possibly harm both core and periphery nations. Alternatively, they suggest that a tax floor is a relative better policy because it leads to a weak Pareto improvement that makes the low-tax nation indifferent, while the high-tax nation would be better off. Finally, Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud (2003) shows that when countries are asymmetric, tax competition with trade liberalization may produce a “race to the top”. This is because decreasing trade costs raise real per capita income in all nations. To see this, suppose that public amenities are a luxury good. Periphery governments may raise their tax rates when trade gets freer. This will give a core-nation an opportunity to raise its tax rate even faster than the periphery nation because of hump-shaped agglomeration rents. When trade freeness is high enough, the agglomeration rents begin to decrease, and then the core-nation tax rate would fall relative to the periphery’s rate.

Behrens and Picard (2005) analyse subsidy competition between two countries in order to attract capital. Their framework builds on Ottaviano and van

Ypersele (2005), who assume a quasi-linear utility function for the representative consumer. Not only do they allow firms to choose their location, but also the number of plants they operate. So, their choices are whether to set up a plant in the home country and export to foreign markets, or to set up a plant in a foreign country then export back to home country, or to set up a plant in both countries and sell their products locally. In the last two scenarios, firms are considered to be Multinational Corporations (MNC). They show that when the cost of a second plant is large relative to the costs of exporting goods, firms prefer to operate a single plant. Firms will relocate their plant to any country that raises its subsidy. This relocation of firms will increase competition in the market in this country and decreases it in the other country. When the cost of a second plant is small relative to the costs of exporting goods, some firms will prefer to operate in both countries. In this case, competition will, therefore, increase globally. Higher competition will reduce prices of goods and firms' operating profits before subsidies. However, a subsidy does not offset the fall in profits; therefore profits after subsidy actually decrease. Furthermore, Behrens and Picard (2005) suggest that the impacts of subsidies on firms' location and organization choices affect governments' equilibrium subsidies. In the absence of MNCs, firms locate according to subsidy differences and competition for mobile capital encourages governments to inflate subsidies, which is compatible to those of the BTCM results. However, higher subsidies reduce the cost of capital and may affect firms' organization, such that firms may choose to set up plants in all countries. When a number of MNC type firms operate in all countries, governments will set their subsidies at the point where any further decrease in subsidies would persuade some MNCs to change their structure. These changes would make consumer worse-off. As a consequence, the competition for mobile capital is less

intense once a sufficient mass of multinationals operate in the global economy, and the “race to the bottom” competition does not occur.

Apart from corporate income tax competition, Mai, Peng and Tabuchi (2008) analyse a tariff competition between two countries based on a conventional NEG model framework. They assume that trade costs can be divided into of two categories, i.e. transport costs and tariffs. Transport costs are considered exogenous, while tariffs are endogenous. They argue that the core-periphery pattern occurs if the transport costs are sufficiently small. In this case the core country imposes a positive tariff, while the periphery tariff is zero. If transport costs are high, both countries have an incentive to raise their external tariffs to attract firms. This positive tariff would adversely affect the other country. This will lead to tariff competition, which harms both countries.

3.5 Conclusion

The literature on Preferential Trade Agreements has continuously attempted to demonstrate the disadvantages and advantages of the formation of PTA. However, the majority of researches generally focus on its effects on the member countries. The welfare effect of the PTAs is also ambiguous. The effect on optimal tariffs depends on the type of formation. However, there is one particular common consensus regarding the effects of PTAs, which is that it causes production shifting from the excluded countries to PTAs member countries.

Regarding tax competition, the two major approaches generally provide different conclusions in terms of locational effects and tax levels. The NEG approach suggests that tax competition does not always lead to an inefficiently low level of tax

and capital may become quasi-immobile. Additionally, there may emerge the case that tax competition leads to a race to the top. Contrary to the NEG, the standard BTCM approach generally suggests that tax competition leads to an inefficiently low level of tax and capital elastically responds to the difference in tax rates. Although recent papers that use an extension of the standard BTCM can produce a similar results to that of the NEG approach. In addition, most of tax competition researchers use a two-region model to investigate the locational and welfare effects of tax games between governments. Only few use a multi-region framework to investigate tax competition with the presence of PTAs.

It is seem that there is a connection between Preferential Trade Agreements and tax competition, given that the responsiveness of firms or capital to changes in government policies is the main factor that causes intergovernmental competition. In addition, the formation of PTAs generates production shifting from the outsiders. Regarding these effects, PTAs formation may have adverse effects on the excluded countries that may result in inter-regional tax competition. Nonetheless in the extensive literature on Preferential Trade Agreements and tax competition, this connection has not been fully analysed so far in the literature. This provides us with a motivation to examine this connection in further detail.

Chapter 4

A Three-Country Computable General Equilibrium Model of a Preferential Trade Agreement Area

4.1 Introduction

Three of the most distinct characteristics of the current global economic environment are the increasing degree of regional integration, the growing importance of the (international) vertical fragmentation of production, and a fall in the barriers to capital mobility. These phenomena allow investors to gain greater freedom to take advantage of and develop a greater sensitivity to foreign economic opportunities. As previously discussed, the main objectives of the thesis are to study the effects of the formation of preferential trade agreements and/or corporate income tax competition on the location of industries. In this chapter we construct a multi-region model to examine the effects of the formation of a Preferential Trade Agreements (PTA) on industry location; specifically, we consider a group of countries that form a PTA and impose Most Favoured Nation (MFN) tariff rates on imports from the rest of the world, whilst governments apply a zero rate on trade between countries inside the PTA bloc. Taking into account that goods trade has become more vertical, as intermediates account for an increasing share of total trade, we base our model on the Footloose Capital Vertical Linkage model (FCVL) developed by Baldwin et al.(2003) and Robert-Nicoud (2006), which is one variation of the New Economic Geography models.[12] One of the distinct features of this model is that it explicitly

[12] The growing importance of the (international) vertical fragmentation of production can be reflected in an increasing amount of intermediate goods trade. Hummels, Ishii and Yi (2001) found that, as of 1990, the ratio of imported input content of exports of 10 OECD and four emerging markets countries was 0.2, whereas the ratio for smaller countries was as high as 0.4. Additionally, this ratio grew by

models firm-to-firm sales of intermediates that are used as factor inputs in the production by single-plant national firms. Thus, the model incorporates the vertical fragmentation of production into the analysis.

Generally, the New Economic Geography models use an ad hoc migration equation to govern the movement of either skilled labour or capital between countries. In this thesis, we introduce a capital allocation mechanism that is underpinned by an assumption of imperfect substitutability between the capital stocks from different countries to the model instead of using an ad hoc equation. As a result, an investor may prefer to invest in a particular country rather than in others. Specifically, the allocation of capital is characterized by a constant elasticity of transformation function (CET).

Analyzing the stability of the model, we find that the symmetric equilibrium, in which the mass of firms operating in each country is spread equally, is stable for almost all levels of tariff rates and degrees of vertical linkages. Multiple equilibria can occur, particularly when the level of vertical linkages is very high. With the exception of the symmetric equilibrium, the other equilibria are mostly unstable. Agglomeration generally occurs at intermediate levels of tariffs. However, the level of tariffs alone is not sufficient to trigger agglomeration. The key mechanism underpinning agglomeration is the presence of vertical linkages among firms in the manufacturing sector. Finally, we find that a unilateral increase in capital income tax has ambiguous effects on both the allocation of firms and the real income of consumers. Specifically, we find that a race-to-the-bottom does not appear to occur when trade is either perfectly free or subject to sufficiently high tariffs. These results contrast with those obtained within the basic tax competition model with imperfect

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about 30% between 1970 and 1990. Yi (2003) found that this ratio for the U.S. was 0.22 in 1997 and that it had grown by about 30% between 1962 and 1997.

competition which generally suggests that competition for mobile firms causes countries to compete their tax rates down to zero.

The chapter proceeds as follows. Section 4.2 outlines the three-country model in a new economic geography setting. In section 4.3, we analyse the model with three symmetric countries including the presence of trade barriers. In this section, we investigate the effects of the key parameters and variables on the behavior of the model. Section 4.4 concludes the chapter.

4.2 The Model

We assume a world consisting of three countries, where each country has two sectors and two primary factors of production. The three countries are symmetric in terms of tastes, technology and factor endowments. We shall consider the situation in which two of the countries form a Preferential Trade Agreement (PTA) and the third country acts as the 'rest of the world'. The basic characteristics of the model are as follows.

The institutions in each country are represented by households, producers and the government. The households are endowed with fixed amounts of capital and labour. A typical household is assumed to supply labour and capital inelastically. It receives income from wages and the interests on capital in return to their supply of labour and capital. Households are assumed to be immobile between countries. However, they are freely mobile between sectors within their country of residence. The total amount of capital owned by households in each country is fixed. Capital is assumed to be perfectly mobile between sectors and countries. Households can decide to invest in any country to maximise their return to capital and all of the capital return will be repatriated. Thus, a discrepancy between the total amount of

capital owned by households in one country and the total amount of capital employed in that country may exist.

The two sectors are agriculture (*A*) and manufacturing (*M*). The *A* sector is perfectly competitive and produces a single homogeneous good with a constant returns to scale technology. On the other hand, the *M* sector is imperfectly competitive and produces a large variety of differentiated goods with an increasing returns to scale technology[13]. In this model, the homogeneous good is considered to be the residual, perfectly competitive sector that is the counterpart to the action taking place in the increasing returns, imperfectly competitive differentiated sector. We assume that labour is the only primary factor input used in the production of the homogenous good. There is a very large number of potential manufactured goods, so many that the product space can be represented as continuous. Capital, labour and intermediate goods are required in the production of the differentiated goods. Specifically, we assume that a fixed amount of capital is required to start production, whilst a composite input consisting of labour and intermediates is required as a variable input in production.

The agricultural and differentiated goods are sold both domestically and internationally. The former is freely trade internationally. The latter may incur the imposition of tariffs by the importing countries. This set up is unlike the other New Economic Geography (NEG) models, which usually assume that trade in

[13] The fact that the product markets are far from perfectly competitive in reality can be addressed in a number of ways. The first one is to assume a monopolistic market. However, Chamberlin (1951) suggests that a pure monopoly only exists when a single authority controls every economic good. Hence, no competition exists in the market, which would be the case under state socialism only. The second option is to assume an oligopolistic market, which would be a more ideal market structure. However, as discussed in Neary (2003), this type of market structure is proven difficult to model it within a general equilibrium framework. The third option is to assume monopolistically competitive markets, where each firm chooses to produce a good that is slightly different from the next. Therefore, each firm has some degree of monopoly over its own product. The number of firms is considerably large so that any individual firm cannot influence market prices and a strategic interaction among firms is ruled out. We choose to follow this route in this chapter.

differentiated goods incurs iceberg trade cost. To start with, we assume that only tariffs are present in the model. This allows us to introduce other forms of trade cost to the model in the future research.

The typical consumer in each region spends all of his/her income on the consumption of both *A* and *M* goods – both either domestically produced or imported. As explained, the market for good *A* is perfectly competitive with free entry and no trade cost incurred. Firms in the manufacturing sector are assumed to be of Dixit-Stiglitz's monopolistically competitive type.[14] Each firm specializes in one variety of the differentiated good and is small enough to be negligible – i.e. they do not interact strategically with each other and take the industry price index as given. Free entry into the industry implies that firms in this sector have no pure profits in equilibrium. They, however, enjoy monopoly power that results from product differentiation and 'love-of-variety', i.e. they face a downward-sloping demand curve; the price of the good is marked-up over marginal cost in equilibrium Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud (2003, Hart (1985).

The demand for the variety produced by each firm in the *M* sector, stems not only from consumers but also from all other firms in the industry since they use a basket of the manufacturing varieties as an intermediate input in order to produce their final consumption differentiated good. As pointed out by Baldwin et al. (2003) and Robert-Nicoud (2006), the differentiated goods sector can be thought of as a single sector of many goods. Therefore, following Krugman and Venables (1995), we can introduce input-output linkages without actually having to introduce any

[14] There are several approaches to model monopolistic competition. The models by Dixit and Stiglitz (1977)and Spence (1976) are closely related. However, the Dixit and Stiglitz (1977) model has become the 'workhorse' model of monopolistic competition since it solutions can be derived explicitly. An alternative specification is the Lancaster (1980) model. However, this model is not easy to work with within a general equilibrium framework.

additional industries. This can be done by assuming that each firm in the differentiated sector uses its own product – together with all other manufacturing varieties – as an input. Assuming, for simplicity, that the same CES aggregator is used for both consumers and firms, the same basket of differentiated varieties demanded by consumers is also an input into the production of each variety. Thus, the manufacturing industry acts as both a downstream (producing output for final consumption) and an upstream (producing intermediates for the manufacturing sector) sector.

Following Baldwin and Krugman (2004), we assume that the government is benevolent: its objective is to maximise social welfare. The government imposes a tax rate on the return to capital, defined as the operating profit from each firm located in and operating from within the country. Furthermore, the government levies a tariff over the imported manufacturing varieties. Following Raff (2004), we also assume that the tax revenue is redistributed by the government to consumers in a lump-sum fashion.

We use the subscripts r and s to indicate the spatial characteristic of the variables, where r represents the home country and s represents the foreign country. Hence, $r,s \in R = \{1,2,3\}$. Thus, when we attach a single subscript letter to a variable, this will define the 'location' of that variable: e.g. $x_r^S(i)$ denotes firm's total supply for a variety *i* of the *M* good from country r. On the other hand, when we apply a pair of subscript letters to a variable, the first subscript letter indicates the location where the variable is supplied from and the latter means the location where the variable is consumed in: e.g. $m_{s,r}(i)$ denotes demand for a variety *i* of the *M* good in

home country r, with the good either being imported from foreign country s, if $r \neq s$, or being produced domestically, if $r = s$.

4.2.1 The household

The typical consumer in each region has a two-tier utility function. The upper tier is of a Cobb-Douglas functional form, which describes consumer's preferences over the homogeneous good and all differentiated goods. The second tier is of a CES functional form, which describes the consumer's preferences over the various differentiated varieties. Thus, the upper tier utility function of the representative consumer in each country is given by:

$$U \equiv A_r^{1-\mu} M_r^{\mu} \tag{4.1}$$

The lower tier utility function is

$$M_r = \left(\int_0^{n^w} m_{s,r}(i)^{1-(1/\sigma)} \, di \right)^{\frac{1}{1-(1/\sigma)}}; \quad 0 < \mu < 1 < \sigma, \quad r, s \in R \tag{4.2}$$

where A_r and M_r are the quantities consumed of the homogeneous good *A* and of the composite differentiated good *M* respectively, and n^w is the mass of all the available varieties of the differentiated good. Thus, $n^w = \bigcup_{r \in R} n_r$.

Households' income (Y_r) originates from three sources (i.e. wage or labour income, returns from capital investment, and government transfers) and is expressed by:

$$Y_r = w_r L_r + \sum_{s=1}^{3} (1 - t_s) r_s K_{r,s} + TR_r; \quad r, s \in R \tag{4.3}$$

where w_r is the wage rate, L_r is the households' labour endowment, t_s is the capital income tax rate in country *s*, r_s is the return to capital, $K_{r,s}$ is the amount of investment in country *s* from country *r*'s investors and TR_r is the government transfer to households in country *r*. We also assume that there is no saving, so consumer's income equals consumer's expenditure. Given expenditure and a set of prices, $P_{A,r}$ for agricultural good and $P_{M,r}$ for the differentiated good, the consumer's problem is to maximise utility subject to the budget constraint, which is

$$Y_r = P_{A,r}A_r + P_{M,r}M_r; \quad r \in R \tag{4.4}$$

As a result, consumers' demand for the *A* good in each country is given by

$$A_r = \frac{(1-\mu)Y_r}{P_{A,r}}; \quad r \in R \tag{4.5}$$

and consumers' demand for the *M* good is

$$M_r = \frac{\mu Y_r}{P_{M,r}}; \quad r \in R \tag{4.6}$$

where, $P_{M,r}$ is the corresponding CES price index, which is given by

$$P_{M,r} = \left(\int_0^{n^w} \left(\tau_{s,r} p_s(i) \right)^{1-\sigma} di \right)^{1/(1-\sigma)}; \quad r \in R \tag{4.7}$$

where, $p_s(i)$ is the price of a variety *i* produced in country *s* and $\tau_{s,r}$ is the trade cost (tariff) incurred by consumers in country *r* when importing a unit of the good

from country *s*. Thus, the total price that consumers in country *r* have to pay for one unit of good *i* is $\tau_{s,r} p_s(i)$.

The lower-level of the consumer's problem then involves choosing the amount consumed of each variety *i*, $m_{s,r}(i)$, to maximize his or her utility function subject to the budget constraint determined by the allocated expenditure on the *M* good. Given the composite CES basket of the differentiated varieties, this will involve maximising

$$M_r = \left(\int_0^{n^w} m_{s,r}(i)^{1-(1/\sigma)} \, di \right)^{\frac{1}{1-(1/\sigma)}}; \quad r, s \in R \tag{4.8}$$

subject to the budget constraint

$$\mu Y_r = \int_0^{n^w} \tau_{s,r} p_s(i) m_{s,r}(i) \, di; \quad r, s \in R \tag{4.9}$$

By applying Shephard's lemma to (4.4) and making use of (4.6) and (4.7), this process yields the following consumer demand for variety *i* of the *M* good,

$$m_{s,r}(i) = \left(\frac{\mu Y_r}{P_{M,r}} \right) \left(\frac{\tau_{s,r} p_s(i)}{P_{M,r}} \right)^{-\sigma}; \quad r, s \in R, \; i \in n^w \tag{4.10}$$

where $P_{M,r}$ is the same CES price index given in (4.7).

4.2.2 The A-sector

We assume that the agricultural sector is perfectly competitive and produces a single, homogeneous good, using a constant-returns to scale technology. Trade in the agricultural good is frictionless both within a country and internationally. In the *A* sector labour is the only primary factor required in production. Specifically, we

assume that *a* units of labour, $L_{A,r}$, are required to produce one unit of the *A*-good, A_r^S. Thus, the production function for the homogenous good is

$$L_{A,r} = aA_r^S; \quad r \in R \tag{4.11}$$

with cost function:

$$C_{A,r} = w_r L_{A,r}; \quad r \in R \tag{4.12}$$

Price-taking profit maximising behaviour then implies that the price of the *A*-good, $P_{A,r}$, equals marginal cost:

$$P_{A,r} = aw_r; \quad r \in R \tag{4.13}$$

In the absence of trade frictions, trade equalises the prices of this good across countries. Using this good as the numeraire, normalising its price to unity, and setting $a = 1$, then we obtain $P_{A,r} = w_r = 1$ for all $r \in R$.

4.2.3 The M-sector

In the monopolistically competitive differentiated sector, increasing returns to scale give an incentive to specialisation. Each manufacturing firm is thus assumed to produce a single variety of the good. Given the love of variety implied by the CES aggregator, consumers' utility increases as the number of varieties of the good consumed increases. In addition, the symmetry with which goods enter the CES aggregator implies that every variety competes equally with all other varieties, so a manufacturing firm would always choose to produce a variety that has not been produced by another firm. In doing so, a firm avoids sharing the demand for its

variety with another firm. Free entry and exit in the differentiated sector ensures that there are no pure profits in equilibrium for firms. Moreover, the cost of producing a given amount of the differentiated good is the same for all varieties. Specifically, we assume that in order to produce a variety, each firm requires a fixed amount of capital, K, to start producing and a constant amount of composite input, $I_r(i)$, made up of labour, $L_{M,r}$, and intermediates produced by sector *M* itself , $Z_r(i)$, for each unit of output it produces:

$$I_r(i) = \beta x_r^S(i); \quad r \in R \tag{4.14}$$

where β denotes the inverse of the marginal product of the composite input and $x_r^S(i)$ denotes the quantity of output of variety *i*. We assume that labour and the varieties of good *M* are combined into the composite input *I* according to a Cobb-Douglas technology with shares *1-*γ and γ respectively:

$$I_r(i) = \left(\frac{L_{M,r}}{1-\gamma}\right)^{1-\gamma}\left(\frac{Z_r}{\gamma}\right)^{\gamma}; \quad r \in R, \quad 0 < \gamma < 1 \tag{4.15}$$

The intermediate input, Z_r, used in production consists of all available varieties of the differentiated goods produced in the world, which are aggregated according to a CES technology that is identical to the consumer preference aggregator. Thus:

$$Z_r = \left(\int_0^{n^w} z_{s,r}(j,i)^{1-(1/\sigma)}\, di\right)^{\frac{1}{1-(1/\sigma)}}; \quad r,s \in R, \quad \sigma > 1, \quad i \in n_r, \quad j \in n^w \tag{4.16}$$

where $z_{s,r}(j,i)$ is the amount of variety *j* produced in country *s* used as an intermediate input to produce variety *i* in country *r*. Then, a manufacturing firm

minimises the total cost of producing a given level of output for some fixed factor prices subject to the firm production technology. The resulting total cost function of a typical manufacturing firm *i* is:

$$C_{M,r}(i) = \alpha r_r + \beta \Omega_r x_r^S(i); \quad r \in R, \quad i \in n_r \tag{4.17}$$

where α is the fixed requirement of capital needed to start production and Ω_r is the intermediate input price index. The input price index, Ω_r, is a weighted composite of the wage and the of the CES price index, $P_{M,r}$ with shares *1-*γ and γ respectively:

$$\Omega_r = w_r^{1-\gamma} P_{M,r}^{\gamma}; \quad r \in R, \; 0 \le \gamma < 1 \tag{4.18}$$

The firm's problem is to set its price to maximise its profit. The latter is given by:

$$\pi_r(i) = p_r(i) x_r^S(i) - r_r \alpha - \beta \Omega_r x_r^S(i); \quad r \in R, \quad i \in n_r \tag{4.19}$$

where the first term on the RHS is the firm's total revenue. The profit maximising price, $p_r(i)$, is given by:

$$p_r(i) = \frac{\beta \Omega_r}{1-(1/\sigma)}; \quad r \in R, \quad i \in n_r \tag{4.20}$$

This equation implies that the profit-maximising price is a constant mark-up over marginal cost.

Next, by applying Shephard's lemma on the firm's total cost function, we can derive the firm's conditional demands for the differentiated good and for labour, respectively given by

$$z_{s,r}(j,i)=\left(\frac{\gamma\beta\Omega_r x_r^S(i)}{P_{M,r}}\right)\left(\frac{\tau_{s,r}p_s(i)}{P_{M,r}}\right)^{-\sigma};\quad r,s\in R,\ \ i\in n_r,\ \ j\in n^w \tag{4.21}$$

and

$$L_{M,r}=\frac{(1-\gamma)\beta\Omega_r}{w_r}\int_0^{n_r}x_r^S(i)\,di;\ \ r\in R \tag{4.22}$$

4.2.4 The equilibrium

Free entry and exit ensures that there are no pure profits in equilibrium for firms in the *M* sector. Thus, the zero profit condition for a typical monopolistically competitive firm is

$$p_r(i)x_r^S(i)-r_r\alpha-\beta\Omega_r x_r^S(i)=0;\ \ r\in R,\ \ i\in n_r \tag{4.23}$$

Using (4.10) and (4.21), aggregating over all available varieties and rearranging, we obtain the total expenditure on the *M* good:

$$E_r=\mu Y_r+\gamma\beta\Omega_r\left(\int_0^{n_r}x_r^S(i)\,di\right);\quad r\in R \tag{4.24}$$

The first term on the RHS is consumers' expenditure on the *M* good and the second term is expenditure on intermediates by firms. The total demand for a single variety of the good in one country is then made up of the sum of consumers' demand and factor inputs' demand for that variety from every country, which is given by

$$x_{r,s}(i)=m_{r,s}(i)+\int_0^{n_s}z_{r,s}(i)\,di;\quad r,s\in R \tag{4.25}$$

Using (4.10) and (4.21), aggregating over all available varieties and rearranging, we can express the total demand for a single variety in one country as a function of the total expenditure on the *M* good as

$$x_{s,r}(i) = \left(\frac{E_r}{P_{M,r}}\right)\left(\frac{\tau_{s,r} p_s(i)}{P_{M,r}}\right)^{-\sigma}; \quad r,s \in R \tag{4.26}$$

Then, the total supply of a variety of the *M* good equals the total demand for this variety from the three countries, that is

$$x_r^S(i) = \sum_{s=1}^{3} x_{r,s}(i); \quad r,s \in R \tag{4.27}$$

This equation is the *M*-good market clearing condition, which states that there is neither excess supply nor excess demand for this good.

The labour market clearing condition is

$$L_{A,r} + L_{M,r} = L_r, \quad L_{A,r} > 0; \quad r \in R \tag{4.28}$$

where the LHS is total demand for labour, which is made up of the sum of labour demands from the *A* sector and the *M* sector in each country, and the RHS is a total supply for labour in each country. As we shall discuss, in the calibrations of the initial equilibrium we shall assume that labour demand from the *A* sector is positive in every country, i.e. that each country produces a positive quantity of the *A* good. This, together with the production technology in this sector and the free trade in the agricultural good (whose price is normalised to unity), ensures that the wage rate is equalised internationally. Clearly, should the *A*-sector not exist in some country, all labour in such country would end up working for the *M* sector. As a result, should a

country fully specialise in the manufacturing sector, the wage rate would no longer equalise across countries.

In equilibrium, the capital market in each country is required to meet the capital market clearing condition:

$$\sum_{s=1}^{3} K_{s,r} = \alpha n_r; \quad r, s \in R \tag{4.29}$$

where the LHS is the total supply of capital from every countries to country *r* and the RHS is the total demand for capital, which is made up of the demand for capital by each firm multiplied by number of firms in country *r*.

The capital allocation mechanism in this model is underpinned by an assumption of imperfect substitutability between the capital stocks from different countries. This imperfect substitutability may result from investors having different information and knowledge about the economic conditions in different countries. Then, an investor may prefer to invest in a particular country rather than in others. This interpretation of 'knowledge capital', which implies that capital can be differentiated by origin, is suggested by Markusen (2002) and also used in Lejour, Rojas-Romagosa and Verweij (2008). Specifically, the allocation of capital is characterized by a constant elasticity of transformation function (CET). Households' problem is to maximise the total net return to capital, $\sum_{s=1}^{3}\left(1-t_s\right) r_s K_{r,s}$ subject to the constraint given by the aggregate capital stock,

$$K_r = \sum_{s=1}^{3} K_{r,s}; \quad r \in R \tag{4.30}$$

The allocation of capital across countries, $K_{r,s}$, is then a function of the relative net rate of return to capital:

$$K_{r,s} = K_r \left(\frac{(1-t_s) r_s}{RI} \right)^{\psi} ; \quad r, s \in R \quad , \psi > 0 \tag{4.31}$$

where

$$RI = \left[\sum_{r=1}^{3} \left((1-t_r) r_r \right)^{\psi} \right]^{\frac{1}{\psi}} ; \quad r \in R \tag{4.32}$$

is an index of net return to capital in the three countries, t_s denotes the capital income tax rate imposed by country *s* government and the parameter ψ is the elasticity of transformation between countries. Thus, ψ is the parameter that determines the extent of capital mobility. The degree of capital mobility between countries is perfect when ψ approaches infinity. On the other hand, capital is immobile when ψ approaches zero. For $0<\psi<\infty$ capital mobility is imperfect.

4.2.5 The government budget

We assume a benevolent government whose objective is to maximise social welfare. The government revenue stems from imposing a tax on the return to capital invested in every firm in the country, CIT_r and an tariff on the imports of the *M* goods, TAR_r. Total tax revenue is redistributed to consumers, TR_r, in a lump-sum fashion. Thus the government budget constraint is:

$$TR_r = TAR_r + CIT_r ; \quad r \in R \tag{4.33}$$

With respect to its tariff policy, governments can choose to levy a general tariff rate on imports of the *M* good from all other countries, i.e. a Most Favoured Nation tariff rate (MFN). Alternatively, as a member of a preferential trade agreement, a government may choose to grant preferential treatment to some countries and apply a Preferential Trade Agreement tariff rate (PTAs) to the imports from these trading partners. Therefore, tariff revenues will be given by

$$TAR_r = \sum_{s=1}^{3} \left(\tau_{s,r} - 1\right) n_s p_s\left(i\right) x_{s,r}\left(i\right); \quad r,s \in R \tag{4.34}$$

where $\tau_{s,r} \geq 1$ is the tariff for imports into country *r* from country *s*.

Additionally, the capital income tax revenue is obtained by imposing tax on the return to capital from all firms that operate in the country. Hence, we assume that governments impose the same tax rate to all firms operating in their country regardless of the origin of the capital they employ. Thus, capital tax revenue equals the sum of tax revenue collect from return to the capital to every country, which is given by

$$CIT_r = t_r r_r \sum_{s=1}^{3} K_{s,r}; \quad r,s \in R \tag{4.35}$$

4.2.6 The balance of payments

With international trade, an economy is no longer constrained to consume only goods that are produced within the country. Thus, we require the current account balance for all good and capital transactions to clear. The current account balance comprises of the trade balance, TB_r, and the capital account FI_r. The

former is the account for the country's total trade in goods and is determined by the difference between the value of the country's imports and the value of its exports:

$$TB_r = P_{A,r}\left(A_r^S - A_r\right) + n_r p_r(i) x_r^S(i) - \sum_{s \neq r} n_s p_s(i) x_{s,r}(i); \quad r,s \in R \tag{4.36}$$

where the first term on the RHS defines the value of the excess supply of the *A* good in country *r*. If this value is positive, the country is an exporter of the *A* good. If instead the value is negative, the country is an importer of this good. The second term is the total value of the *M* good produced in country *r*. The third term is the total value of the *M* good consumed in country *r*. If the sum of the second and third terms is positive, the country is a net exporter of the *M* good. On the other hand, the country is a net importer of the good if this difference is negative.

The capital account is given by

$$FI_r = \sum_s (1-t_s) r_s K_{r,s} - (1-t_r) r_r \sum_s K_{s,r}; \quad r,s \in R \tag{4.37}$$

where the first term on the RHS is the total net return to capital that households receive from their investments in every country. The second term is the total net return to capital that all firms in country *r* pay their investors. If the sum of these terms is positive, the country's capital account is in surplus. If it is negative, the country runs a capital account deficit. A country's current account has to be balanced, therefore the sum of the trade balance and of the net capital income must equal zero:

$$TB_r + FI_r = 0; \quad r \in R \tag{4.38}$$

4.3 Model characteristics: comparative static analysis

Ultimately, in our analysis, the objective of the government is to attract investment in the country, which effectively amounts to attracting firms to operate in the country. The government key policy instruments are the tariff rate $\tau_{s,r}$ and the capital income tax rate t_r. In this section, we first examine the stability of equilibria in response to an exogenous relocation of firms among countries. Specifically, starting from a symmetric equilibrium, in which the mass of firms operating is spread equally across the three countries, firms in country 2 and 3 start relocating to country 1. The relocation of firms from country 2 and 3 is assumed to be symmetric. The relocation of firms continues until all firms operate in country 1.[15] We also consider the situation in which firms in country 1 start relocating to country 2 and 3 symmetrically. The immediate effect of these exogenous perturbations is that the zero profit condition of firms in equilibrium no longer holds. We have used a numerical simulation to help us analyse the behavior of the model. We conduct the experiments with different combinations of level of tariff rate and of the vertical linkages parameter γ. In particular, we choose the following parameter values: $L_r = 100$, $K_r = 100$, $\alpha = 1$, $\beta = (\sigma - 1)/\sigma$, $\gamma = 0.7$, $\mu = 0.75$, $\psi = 5$ and $\sigma = 8$.[16] We then run simulations with three different levels of tariff rate, i.e. 5%, 30% and 70%, respectively, and with four different levels of vertical linkages: $\gamma = 0$ (i.e. no vertical linkages among firms), and $\gamma = 0.25, 0.50, 0.75$ (i.e. low, intermediate and

[15] The relocation of firms is exogenously determined to see how many equilibria exist and which are stable. Specifically, we examine the whole range of possible firms' location (i.e. we consider the whole range of n_1 / n^W =[0,1]).

[16] Broda and Weinstein (2006) use disaggregated U.S. import data for the period between 1972 and 2001to estimate the elasticity of substitution. They find that during 1972 – 1988 the values of the average elasticity of substitution are between 7 and 17. While during 1990 – 2001, the values of average elasticity of substitution are between 4 and 12.

high levels of vertical linkages). The stability of the model is affected by the level of the key variables and parameters we impose, as shown in figures 4.1 – 4.3. Firms have no incentive to relocate and the symmetric equilibrium is stable for almost all levels of the tariff rate and γ. Starting from the symmetric equilibrium, when an additional firm relocates to country 1, firms experience negative profits in country 1 and positive profits in country 2 and 3. If a firm relocates in the opposite direction, such a profit difference becomes positive.

However, the symmetric equilibrium becomes unstable when the level of γ is high and the level of tariff is at intermediate. The additional firms relocating to country 1 results in this case in a positive profit difference. The firms from the other countries will see the opportunity to gain higher profit if they relocate to country 1, which in turn attracts more firms to that country. If the firm relocates in the opposite direction, such a profit difference becomes negative and generates an incentive for other firms moving out of the country.

Multiple equilibria can occur, particularly when the level of γ is very high. With the exception of symmetric equilibria, other equilibria are mostly unstable. The profit difference is gradually changed until it reaches a critical point, where almost all labour in the country is employed in the *M* sector. Then the profit difference will instantaneously change upwards, which is evidenced by the kink in the profit difference curve. This kink is caused by the substitution effect in the production function, which occurs at the point where the additional firm relocates to the country and there is no additional labour supply moving from the *A* sector to *M* sector.[17] As a result of this labour scarcity, firms will substitute labour with intermediates, which

[17] I impose the condition that the *A* sector is always active in every country. As a result of this condition, the wage rate is equalized across countries. To this end, I impose a minimum requirement of labour in *A* sector that keep working in *A* sector. The kink in the curve occur when the number of labour in *A* sector reaches this level and no further labour moves to *M* sector.

instantaneously pushes up the demand for the manufacturing good. This instant rise in demand of intermediate goods causes instant change in the difference in profit on both sides of the symmetric equilibrium.

The strength of these forces depend on the value of τ, γ and ψ. As we know about the effect of trade cost on the location in new economic geography literature, trade costs make consumers feel that imported goods are more expensive than domestic goods, which in turn makes consumers spend relatively more on domestic good. However, a tariff is different from an iceberg trade cost because government transfers tariff revenue directly to consumers. Thus, the imposition of a tariff simultaneously helps increase consumer spending. Nevertheless, the more firms move in the country the lower the tariff revenue (and the tariff burden on consumer prices) is. When agglomeration occurs in a country, the CES price index in that country will be lower than the price index in the other countries. However, at low levels of trade costs, firms will not earn sufficient benefits from agglomerating in one location as the agglomeration has a small effect in terms of lowering production costs, i.e. the value of Ω. In this instance, a symmetric allocation of firms among countries yields higher benefit to firms. At intermediate levels of τ, agglomeration forces become stronger. The larger the number of firms that gathers in a country, the lower the cost of production in that country is. This is a "forward linkage" effect that attracts more firms to the country. Additionally, the larger the number of firms that locate in the country, the higher the expenditure on the *M* good is in that country. This is a "backward linkage" effect that also attracts more firms to the country. The latter relates to the 'home market effect' whereby the country that has higher expenditure attracts more firms and ends up being a net exporter of the good (Krugman, 1980). At intermediate levels of τ, the agglomeration forces overcome

the dispersion forces. The latter originate from a market crowding effect, whereby the market share of each firm decreases as new firms move in the country. As a result, firms will earn lower profits. At high levels of τ, consumers and firms will spend considerably more on domestically produced varieties compared to imported ones, to reduce the incidence of tariffs. This makes domestic revenues for firm more important compared to export revenues. Then, the market crowding effect becomes very strong as new firms move in the market.

However, the level of τ alone is not sufficient to trigger the agglomeration. The emergence of agglomeration in this model crucially rests on the existence of forward and backward linkages, which give rise to a process of circular causation and self-reinforcing agglomeration. The key mechanism that leads to agglomeration is the presence of vertical linkages among firms in the *M* sector, which results from the expenditure on intermediate goods by firms. With firms' mobility across countries, the vertical linkages are the main trigger of agglomeration; when labour cannot migrate to other countries, the expenditure by households is not much different between countries. Thus, the level of γ is crucially important in this model. The higher the value of γ, the stronger the agglomeration forces in that country are.

We now turn to examine the effects of a unilateral increase in capital income tax (CIT) rate in one country, whilst other countries impose a zero CIT rate. We shall now assume that the allocation of firms is endogenously determined (rather than considering, as before, an exogenous relocation of firms among countries). Hence firms freely move among countries. Therefore the zero profit condition continues to hold. We start analyzing the model when the government in country 1 increases its CIT rate unilaterally from zero until it reaches 100%. We then run simulations with three different levels of tariff rates: 0%, 5% and 10%, respectively.

An increase in CIT has a direct effect on the net rates of return to capital, $(1-t_1)r_1$. Thus, if the government in one country increased its CIT rate, investors from every country would instantly receive a lower after tax return to their investment in that country. This policy would incentivise firms to leave that country. However, an increase in CIT also brings about increases in both government revenue and consumer income, which translate into higher total expenditure on the *M* good in that country. This would work towards increasing the rates of return to the firms operating in that country and counteract the negative direct effect on net rates of return to capital in that country. Therefore, an increase in CIT would create both agglomeration and dispersion forces, with the net effects of these forces depending on the level of external tariffs.

We quantify the effects of unilateral increases in CIT rate on the number of firms and the real income in country 1 by means of numerical simulations, shown in figures 4.4 and 4.5. The effect of a unilateral increase in CIT on real income is ambiguous when trade is perfectly free ($\tau_r = 1.00$). This is because at this level of tariffs, a unilateral increase in capital income tax would trigger a strong dispersion force that dominates agglomeration forces – thus resulting in a migration of firms that continues until almost all of the industry leaves country 1. However, the individual variety prices of the *M* good produced in every country do not change when trade is perfectly free. Additionally, individual variety prices are not affected by the change in CIT rate. Consequently, the CES price indices are also equal across countries and unchanged. If the government unilaterally increases its CIT rate, consumers' nominal income would increase as a result of the higher government transfer as long as firms still operate in country 1. Hence, since, the CES price index does not change, consumers' real income would increase until it reaches its peak.

Afterwards real income would gradually decreases and converge to the ex post real income level.

However, the effect of increasing the CIT rate is different when cross-border trade is subject to small tariffs. To see this, in our simulations, we set $\tau_{s,r} = 1.05$. As for the case of free trade, at this level of tariffs, dispersion forces still dominate agglomeration forces and result in a gradual migration of firms from the country until firms are almost no longer in existence in country 1. Country 1's consumers would consume a substantial amount of imported goods because firms relocate to other countries as tariffs are still very low. In this case, however, the CES price index would increase faster than an increase in nominal income. Therefore, if the government unilaterally increases its CIT rate, real income would gradually decrease until firms are almost no longer in existence in country 1.

At a higher level of tariff, e.g. at $\tau_{s,r} = 1.10$, a unilateral increase in capital income tax would create strong agglomeration forces that dominate dispersion force as long as the differences of net rates of return between country 1 and other countries is non-negative. Afterwards, dispersion force would dominate agglomeration forces again. Therefore, a unilateral increase in capital income tax would attract firms to relocate to country 1, with the number of firms in country 1 steeply increasing until it reaches its peak. Afterwards, if the tax rate continued to increase, country 1 would experience a catastrophic migration of firms, with the number of firms dropping – until the industry no longer exists in this country. When firms relocate into country 1, the CES price index falls. The consumers' nominal income also increases as a result of the higher government transfers. Therefore, real income would steeply increase until it reaches its peak, then it abruptly drops when a mass migration of firms will eventually occur: as firms go out of the country, the sudden increase in the CES price

index will result in a fall in real income. These results suggest that a benevolent government may be able to use CIT as a policy instrument to maximize consumers' real income in some situations. In our example, the benevolent government may choose to impose a CIT rate unilaterally to maximise consumers' real income when trade is perfectly free. In such a situation, country 1's real income increases primarily at the expense of country 2 and 3, as shown in figure 4.6. All investors, from all countries, who invest in country 1, pay CIT to country 1's government. Only investors based in Country 1 will benefit from this taxation by receiving (as consumers) their tax expenditure back via government transfer. As a result, investors from Country 2 and 3 would effectively subsidise an increase in real income in Country 1. This transfer of income would occur as long as firms still operate in country 1. Clearly, such a scenario would encourage benevolent governments in the other two countries to respond by increasing their CIT rates to match the CIT rate in country 1. These matching CIT rates would restore the ex post allocation of firms among countries. Consequently, all governments would earn the same amount of CIT revenue and transfer it to their consumers. Therefore, Country 2 and 3's ex ante real income would be raised and Country 1 ex ante real income would fall towards the ex post real income level. This result contrasts with those emerging from standard tax competition models with imperfect competition which generally suggest that competition for mobile firms causes countries to compete their tax rates down to zero (Janeba (1998), Wilson (1999)).

This result also applies to the case in which cross-border trade is subject to sufficiently high tariffs; to see this, we set the tariff rate at 10%. As before, Country 1's benevolent government may choose to increase a CIT rate unilaterally to the level that maximizes their consumers' real income. Similarly, the governments in Country

2 and 3 have an incentive to respond by increasing their CIT rates to match the CIT rate in Country 1. These matching CIT rates would restore the ex post level of real income for all countries again.

However, a country does not have an incentive to unilateral increase its CIT rate when tariffs are very low − which is at 5 % in our example − since doing so would make its consumers worse off. This is because at this level of tariffs, the country that has lower level of CIT would attract firms to move into the country. This, consequently, raises consumers' real income at the expense of the higher CIT rate countries. As a result, the race to the bottom tax competition may occur.

The result that cross-border trade is subject to sufficiently high tariffs is consistent with the proposition in Neary (1993) that the optimal second-best tax on any mobile factor is positive, in the presence of trade restrictions, if and only if that factor is used intensively in sectors subject to higher tariff rates. According toNeary (1993), the unilateral imposition of CIT would reduce capital imports below their optimal level. If the government imposes restrictions on capital-intensive imported goods, the consumers would raise their demand on domestic goods. In this case, tariffs would raise domestic demand for capital and thus encourage a capital inflow – which consequently offsets the reduction of capital and raise welfare. However, such proposition is in contrast to our result when tariffs are very low. The difference stems from the fact that the *M* sector in our analysis is assumed to be imperfectly competitive and produces a large variety of differentiated goods with an increasing returns to scale technology. As a result, there are agglomeration and dispersion forces that determine the equilibrium distribution of firms across locations. If agglomeration forces are stronger than dispersion forces, firms are likely to agglomerate in one country–which generally happens when tariffs are at intermediate

level. On the other hand, firms are likely to spread equally between countries, if dispersion forces are stronger than agglomeration forces – which generally happens when tariffs are either very low or high. When tariffs are very small, they would have a negligible effect on decreasing demand on import and increasing demand on domestic goods, whilst the effect on increasing CES price index is more pronounced. In this case, a small increase in demand for domestic goods is neither sufficient to strengthen agglomeration forces nor to encourage a capital inflow. Therefore, a country would not have an incentive to impose a positive CIT rate when tariffs are very low − which is at 5 % in our example − since doing so would make its consumers worse off.

We have seen from the previous simulation results that the difference in CIT rates between countries can trigger a migration of firms from the high CIT country to the low CIT country. We then use this result to further examine the effect of another key parameter (ψ), which is the elasticity of transformation of capital between countries, upon the strength of agglomeration forces. In so doing, we look at the share of firms in country 1 and other countries at different levels of capital mobility as well as at different levels of tariff. We assume that the governments in country 2 and 3levya 10% CIT rate on the return to capital, whilst the governments in country 1 does not impose any tax on the return to capital. The parameters in the simulation are set such that $\psi = \{0.1, 5, 100\}$ and $1 \le \tau_{s,r} \le 1.5$ where $r, s \in R$ and $r \neq s$ .The elasticity of transformation, ψ, determines the effect of a substitution between the net rate of return from different countries upon the allocation of capital between countries for producing the same given level of total net return of capital. Thus, the elasticity of transformation (ψ) will determine the extent of capital mobility. When ψ approaches infinity, the substitutability between the net rates of return from

different countries is perfect, therefore capital is perfectly mobile internationally. On the other hand, when ψ approaches zero, the substitutability between the net rates of return from different countries is imperfect, therefore capital is internationally immobile. These results are illustrated in figure 4.7. Firms spread equally between countries at all levels of external tariffs when the elasticity of transformation is low, i.e. $\psi = 0.1$.In this case, a low elasticity of transformation works against agglomeration forces. If the elasticity of transformation is at an intermediate level, i.e.: $\psi = 5$, firms agglomerate in country 1 when the external tariffs are at intermediate level. On the other hand, firms spread equally between countries, when the external tariffs are low, high, and prohibitively high. If the elasticity of transformation is at high levels, i.e.: $\psi = 100$, all firms agglomerate in country 1 unless the external tariffs are at prohibitively high levels. In this case, a high elasticity of transformation enhances agglomeration forces.

Thus our simulations indicate that the model potentially generates various results, depending on the values of key parameters and elasticities which turn out to be crucial in assessing the impact of any policy perturbation. Thus, in order to obtain robust and comparable results from further numerical simulations, the values of key parameters and elasticity are needed to be chosen carefully. To this end, we base our choice of the appropriate values for the key variables on the empirical literature as well as from real datasets. Broda and Weinstein(2006)estimate the elasticity of substitution at various levels of aggregation using disaggregated U.S. import data for the period between 1972 to 1988 and 1990 to 2001 and find that - for the sub-interval 1972 – 1988 - the average elasticity of substitution to be 17.3at the seven-digit level TSUSA, 7.5 at the five-digit level SITC and 6.8 at the three-digit level SITC, while for the sub-interval 1990 – 2001 -the average elasticity of substitution to be 12.6 at

the ten-digit level HTS, 13.1 at the five-digit level SITC and 4.0 at the three-digit level SITC.[18] Lejour, Rojas-Romagosa and Verweij (2008)study foreign direct investment using computable general equilibrium framework and argue that the empirical literature does not provide any compelling result on the value of elasticity of transformation. They suggest using the values of parameters that are in line with the specification of other CGE models. Hence, they survey the values of elasticity of transformation that are used in other computable general equilibrium models to study FDI liberalization. They find that the values of the elasticity of transformation between domestic and foreign used in other models range from 3.0 to 6.5. For the share of households' expenditure on the homogenous good $(1-\mu)$, Lancaster, Ray and Valenzuela(1999) conduct a cross-country study of equivalence scales and expenditure inequality using households' survey data from developed and developing countries – viz. Italy, Australia, South Africa, Thailand, Peru, Philippines, India and Tanzania – and show that households' budget shares of non-food in developed countries ranged from 0.7 to 0.76, whilst those shares in developing countries ranged from 0.32 to 0.58. For the level of vertical linkages γ, Di Giovani and Levchenko (2010) use data for 28 manufacturing sectors in 55 countries from 1963 – 2003 from the UNIDO Industrial Statistics Database to calculate a share of output of all sectors needed as intermediate inputs to produce one unit of final output in each sector. They find that petroleum refineries sector has the lowest share of 0.144, while transport equipment sector has the highest share of 0.948 and the average level of share of all sectors is 0.558. For the level of corporate income tax rate, countries' tax rate in 2012 provided by the World Bank ranged from 0 to 65.8. Tax rates between 20% and 30% account for slightly more than 40% of all countries' corporate income tax rates.

[18] TSUSA is the Tariff System of the U.S.A., HTS is the Harmonized Tariff Schedule for the United States and SITC is The Standard International Trade Classification maintained by the United Nations.

Tax rates between 30% and 40% account for almost 30%, whilst tax rates between 10% and 20% account for almost 20%.In order to obtain robust and comparable results from further numerical simulations, we then choose the values of key parameters and elasticity to be used in the benchmark model in the following chapter that are in line with the values that we mentioned above. Specifically, the values of key parameters and elasticity will be: $\sigma = 8$, $\psi = 5$, $\mu = 0.75$, $\gamma = 0.6$, $t_r = 0.25$ and $1 < \tau_r < 1.50$.

4.4 Conclusions

The main purpose of this chapter is to construct a multi-region model that we can subsequently use to analyse the effects of preferential trade agreements and/or corporate income tax competition on the location of industries. One of the distinctive features of the model is that it explicitly models firm-to-firm sales in an input-output fashion. As a result, we incorporate the vertical fragmentation of production into the model. Furthermore, whilst NEG models generally use an ad hoc capital allocation mechanism, we introduce a capital allocation mechanism that is underpinned by an assumption of imperfect substitutability between the capital stocks from different countries. As a result, an investor may prefer to invest in a particular country rather than in others. Specifically, the allocation of capital is characterized by a constant elasticity of transformation function (CET).

Analyzing the stability of the model, we find that the symmetric equilibrium is stable for almost all levels of the import tariff rate and of the vertical linkages parameter. However, the symmetric equilibrium becomes unstable when the high level of γ combines with an intermediate level of tariff. Multiple equilibria can occur,

particularly when the level of γ is sufficiently high. With the exception of the symmetric equilibrium, the other equilibria are mostly unstable.

Firms will not earn sufficient benefits from agglomerating in one location when the government imposes either low or high tariff rates on imports. Agglomeration generally occurs with intermediate levels of τ. However, the level of τ alone is not sufficient to trigger agglomeration. The key mechanism to create agglomeration is the presence of vertical linkages among firms in the *M* sector, which results from the expenditure on intermediate goods by firms.

The agglomeration of firms also depended on the level of the elasticity of transformation, ψ, which will determine the extent of capital mobility. When ψ approaches infinity, the substitutability between the net rates of return from different countries is perfect, therefore capital is perfectly mobile internationally. As a result, firms tend to agglomerate in the country where the net return of capital is higher. On the other hand, when ψ approaches zero, the substitutability between the net rates of return from different countries is imperfect, therefore capital is internationally immobile. Consequently, agglomeration is not likely to occur.

Finally, we find that a unilateral increase in capital income tax has ambiguous effects on both the allocation of firms and the real income of consumers. A unilateral increase in capital income tax – that acts as a dispersion force when trade is either perfectly or relatively frictionless – results in an outflow of firms. On the other hand, a low and intermediate level of capital income tax can create agglomeration forces when the level of tariff sufficiently high and thus results in an inflow of firms. However, a unilateral increase in CIT results in a catastrophic emigration of firms, if CIT rate is sufficiently high. Specifically, we find that the race to the bottom is not likely to occur when trade is either perfectly free or subjects to sufficiently high

tariffs. These results are in contrast to the results of basic tax competition model with imperfect competition where they generally suggest that competition for mobile firms causes the countries to compete their tax rates down to zero.

The theoretical framework developed here is very flexible and can be applied to many different settings. It also seems reasonable to argue that the feature of the model can be extended to more realistic settings such as the incorporation of capital income taxation, asymmetric countries in term of level of vertical linkage, productivity, etc. In the following chapters, we shall apply this model to address the question of the effectiveness of fiscal policies to compete for the internationally mobile capital.

Appendix

4-A Figures

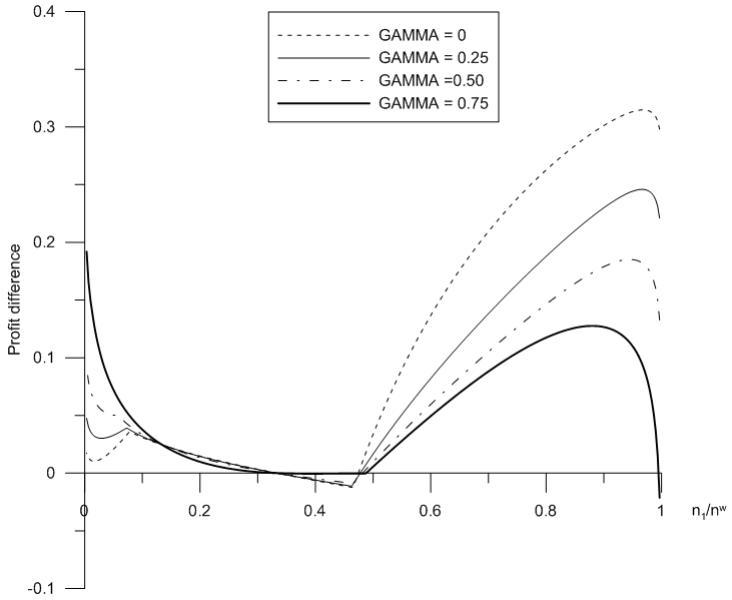

Figure 4.1 Profit gap and local stability; $\tau_{s,r} = 1.05; \quad r \neq s$

The gap between profit in country 1 and the average profit in country 2 and 3

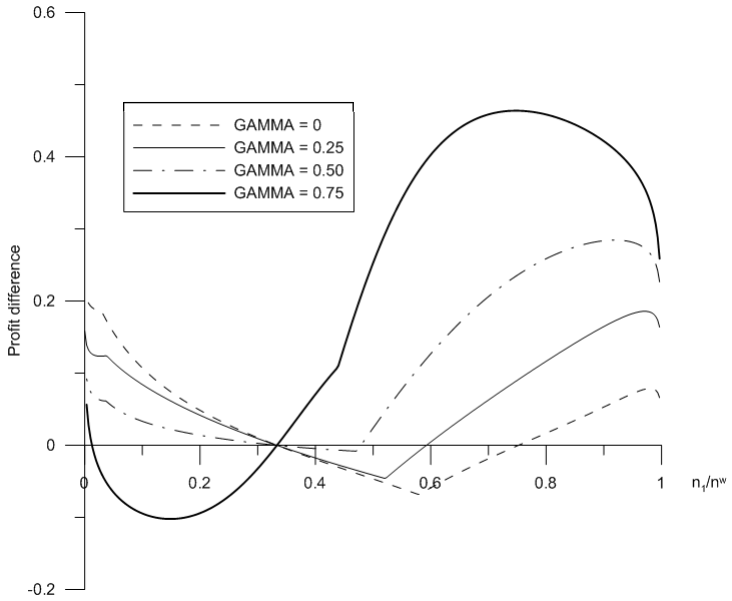

Figure 4.2 Profit gap and local stability; $\tau_{s,r} = 1.30; \quad r \neq s$

The gap between profit in country 1 and the average profit in country 2 and 3

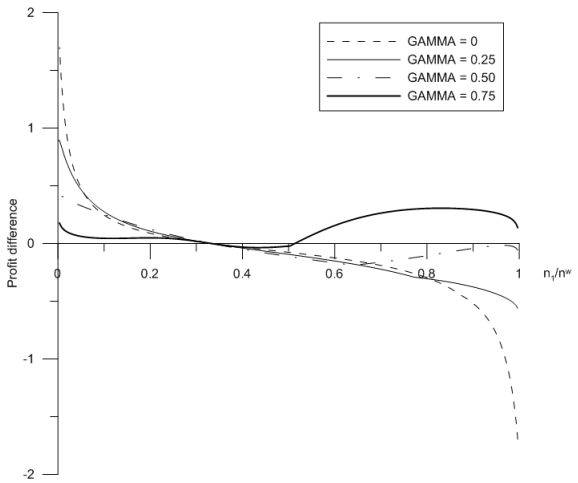

Figure 4.3 Profit gap and local stability; $\tau_{s,r} = 1.70;\ \ r \neq s$**.**

The gap between profit in country 1 and the average profit in country 2 and 3

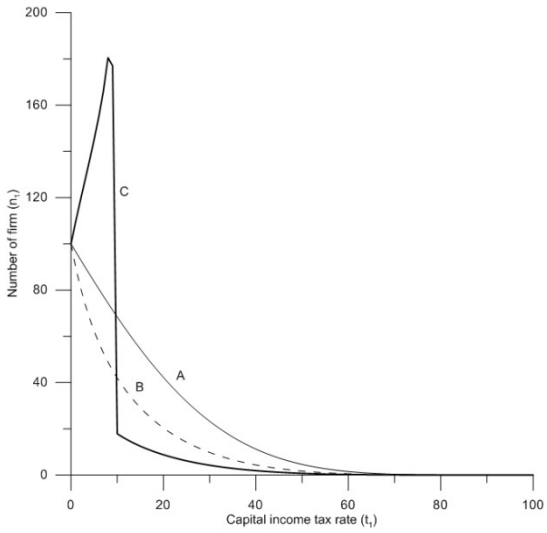

Figure 4.4 Capital income tax and number of firms

The effect of unilateral increase in CIT by country 1 on number of firms, where the external tariffs are (A) 0 %, (B) 5 % and (C) 10 %; the solution is based on $L_r = 100$, $K_r = 100$, $\alpha = 1$, $\beta = (\sigma - 1)/\sigma$, $\gamma = 0.70$, $\mu = 0.75$, $\psi = 5$, $\sigma = 8$.

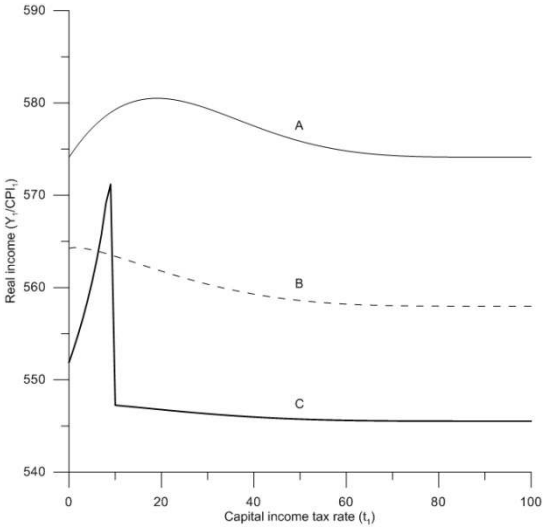

Figure 4.5 Capital income tax and real income

The effect of unilateral increase in CIT by country 1 on real income, where the external tariffs are (A) 0 %, (B) 5 % and (C) 10 %; the solution is based on $L_r = 100$, $K_r = 100$, $\alpha = 1$, $\beta = (\sigma - 1)/\sigma$, $\gamma = 0.60$, $\mu = 0.75$, $\psi = 5$, $\sigma = 8$.

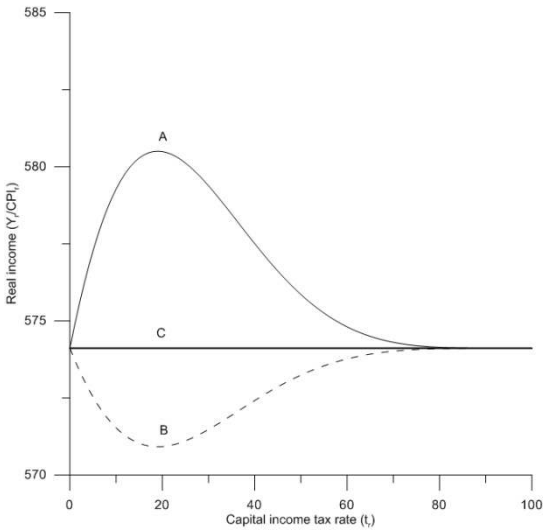

Figure 4.6 Capital income tax and real income

The impact of unilateral increase in CIT on the change in real income in (A) country 1, (B) country 2 and 3 ; (C) the effect of simultaneous increase in CIT by every country on real income in country 1, 2 and 3; the solution is based on $L_r = 100$, $K_r = 100$, $\alpha = 1$, $\beta = (\sigma - 1)/\sigma$, $\gamma = 0.60$, $\mu = 0.75$, $\psi = 5$, $\sigma = 8$.

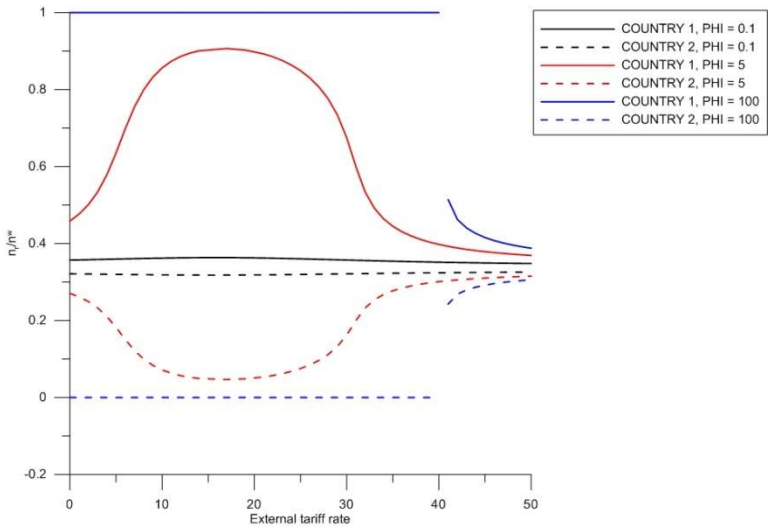

Figure 4.7 Capital mobility and share of firms in Country 1 and 2; $\gamma = 0.5$**.**

The share of operating firms in Country 1 and 2 at different levels of ψ and τ when $t_1 = 0$ and $t_r = 0.1;\ r \in \{2,3\}$.

Chapter 5

Preferential Trade Agreements and Industry Location

5.1 Introduction

Multilateral free trade is widely considered as a first-best scenario for the global economy. However, this scenario has yet to be materialized, since successive rounds of trade liberalisation negotiations under the auspices of the GATT/WTO have been marred by disagreements. Instead, a proliferation of Preferential Trade Agreements (PTAs) has been notified to the WTO in the last couple of decades. This type of trade liberalization can be considered as a second-best scenario. Some would argue that the PTAs are compatible with the goal of multilateral trade liberalization, although others disagree. Nevertheless, the number of agreements is still increasing, as many countries are expecting to sign up to the new ones. One important reason for this to happen is that policymakers perceive that their countries can achieve their development and economic growth objectives and earn other benefits from signing up to such agreements. Schiff and Winters (2003) also suggested that such perceptions can be due to the pressure of globalization and the fear of being left out from its gains while the rest of the world commits to regionalism. Thus, countries perceive there being benefits from signing up to these agreements. The hoped for benefits consist in opportunity to access major markets, increasing competitiveness, access to foreign technologies and investment. Another reason for countries to enter a PTA may be the perception that most countries are too small to act alone in the world economy, and that therefore a country will be better off by pooling with other countries. However partial, regional integration is perceived as a means to ensure reciprocal help between neighbouring countries, to stimulate trade within the region

and – more generally – to be a stepping stone for deeper and possibly wider integration.

In this chapter we implement the three-country model from the previous chapter to analyse the effect of PTA formation on the economies both within and outside the PTA bloc. In particular, we focus on its effects on the location of economic activity and on welfare. We shall assume that country 1 and 2 agree to form a PTA bloc and country 3, which is taken to represent the rest of the world (ROW), has been left out of the agreement. This agreement will mandate both countries to eradicate tariffs on any trade between them. At the same time, both countries still impose tariffs on imports from the ROW, whilst the ROW keep imposing status quo tariff on imports from country 1 and 2.

We find that an eradication of intra-tariff between PTA member countries always attracts investments from the ROW. If the level of vertical linkages is sufficiently high, not only does the PTA formation make PTA member countries better off, but it can also generate a welfare gain in the ROW. However, the ROW may be made worse off at some levels of external tariff rates. Noticeably, a PTA formation between low productivity countries, which leaves high productivity countries out of the agreement, results in an equal dispersion of firms between the PTA member countries and the ROW and tends to make all countries worse off. Instead, not only does a PTA formation between a high and a low productivity country tend to make the PTA member countries − the one with the low productivity in particular − better off, but it can also generate a welfare gain in the ROW. This finding supports the proposition found in the literature that developing countries – generally associated with low productivity − may experience higher benefit from ‘North–South’ agreements than from ‘South-South’ agreements. We also find that

trade creation and trade diversion are not good criteria for the desirability of PTA formation, since a trade creating PTA may make member countries worse off while a trade diverting PTA may make member countries better off.

We shall first examine the effects of two particular types of PTAs, i.e. a Customs Union (CU) and Free Trade Agreements (FTA), within a symmetric country framework – so as to study the effects of a PTA strategy in the simplest environment. We shall then examine the effects of forming the PTA, within an asymmetric country framework in term of endowment and country's characteristics, as a tool to attract and/or retain internationally mobile firms.

The chapter proceeds as follows. Section 5.2 discusses the model that we use to analyse how the formation of a PTA affects firms' location and consumers' welfare. Section 5.3 discusses several important channels in which the effects of PTA formation transmit through to attract investment into the country. Section 5.4 defines the criteria for policy implementation. Section 5.5 shows the simulation results of economic impacts from the PTA formation. In this section, we investigate the effects of the PTA formation when countries are both symmetric as well as asymmetric. Section 5.6 concludes the chapter.

5.2 The effects of a PTAs formation on the structure of the economy

In this section, our main focus is on how the formation of a PTA affects firms' location and consumers' welfare. For ease of exposition, we shall focus on the case in which countries are symmetric in term of labour and capital endowments and use the same technology in production. Then, starting from a situation in which the world economy is already in equilibrium, we shall examine the effects of the formation of a

PTA using the simplest form of a PTA, which is the formation of a Customs Union (CU), by two of the countries.

We further assume that all countries levy the same level of external tariff rate on all imports prior to the formation of a CU. Given our symmetry assumption, in the pre-CU formation equilibrium, the number of firms in the *M* sector is spread equally across all countries. The prices of the *M* good produced in every country are also identical. Then, country 1 and country 2 form a CU area by signing a bilateral agreement to reduce tariff rates simultaneously on imports of the varieties of the *M* good produced in their countries. We shall refer to the agreed new tariff rate as the internal bloc tariff rate or 'intra-CU tariff rate'. These two countries will however maintain their status quo external tariff rates on imports from country 3, to which we shall refer as the 'external tariff rates' or most favoured nation (MFN) tariff rates. The ROW also imposes the same rate of external tariff on imports from country 1 and country 2. Thus, given these assumptions, there are two different sets of import tariff rates: (i) intra-CU tariff rates ($\tau_{2,1}$ and $\tau_{1,2}$), and (ii) external tariff rates, ($\tau_{3,1}$, $\tau_{3,2}$, $\tau_{1,3}$ and $\tau_{2,3}$).[19] Hereafter, to simplify notation, we shall denote both the intra-tariff rates and the external bloc tariff rates as $\tau-\varepsilon$ and τ , respectively – where $0\le\varepsilon\le(\tau_{s,r}-1)$, with $s\neq r$, $s,r\in(1,2)$ is the intra-tariff reduction rate.[20]

After country 1 and 2 decide to form a CU and to reduce their internal bloc tariff rates, the intra-CU import prices of the varieties of the *M* good produced in these countries will start to fall. This, in turn, causes intra-CU demands from country 1 and country 2 for the *M* good, from both consumers and firms, to change at an

[19] $\tau_{1,1}$, $\tau_{2,2}$ and $\tau_{3,3}$ is the sale tax imposed on the domestic goods and is set to 1 in this analysis.

[20] In doing so, we completely rule out the case of import subsidy. The internal bloc tariff rates equal the external tariff rates when $\varepsilon=0$ and the internal bloc tariff rates are zero when $\varepsilon=\tau_{s,r}-1$.

identical rate. Thus, the change in intermediate goods and consumers price indices in country 1 and country 2 will be identical. Under this scenario, the prices of each variety of the *M* good produced in country 1 and country 2 will be equalized, that is: $p_1 = p_2$. Clearly, however, the prices of the varieties produced in the ROW will be different from those produced within the bloc, as trade with the ROW still occurs at the old tariff rates.

For ease of exposition, in what follows we shall discuss the model in terms of country 1 and country 3 – bearing in mind that all equations of country 2 are analogous to those for country 1. Also, we shall not discuss the whole model here, but only the blocks that are immediately relevant for the current analysis and refer the reader to chapter IV for the full model setup.

From (4.20), the profit maximizing price equations of the *M* good in country 1 (i.e. within the CU) and 3 (i.e. in the ROW) are respectively given by:

$$p_1 = \frac{\beta \Omega_1}{1-(1/\sigma)} \tag{5.1}$$

$$p_3 = \frac{\beta \Omega_3}{1-(1/\sigma)} \tag{5.2}$$

where Ω_1 and Ω_3 are the variable input price indices for the countries inside the bloc and the ROW, respectively. Given (5.1) and (5.2), the CES price index in equation (4.7) will be rewritten for country 1 and 3 respectively as:

$$P_{M,1} = \left(\int_0^{n_1} p_1(i)^{1-\sigma} di + \int_0^{n_1} \left((\tau - \varepsilon) p_1(i) \right)^{1-\sigma} di + \int_0^{n_3} \left(\tau p_3(i) \right)^{1-\sigma} di \right)^{\frac{1}{1-\sigma}} \tag{5.3}$$

$$P_{M,3} = \left(\int_0^{2n_1} \left(\tau p_1(i) \right)^{1-\sigma} di + \int_0^{n_3} p_3(i)^{1-\sigma} di \right)^{\frac{1}{1-\sigma}} \tag{5.4}$$

We shall continue to use the *A*-good as the numeraire and normalise its price to unity. Assuming, as before, that the unit labour requirement *a* in the *A* sector is equal to one, and that this good is freely traded, then $P_{A,r} = w_r = 1$ for all $r \in R$. This also allows us to rewrite the variable input price index in equation (4.18) as:

$$\Omega_1 = P_{M,1}^{\gamma} \tag{5.5}$$

$$\Omega_3 = P_{M,3}^{\gamma} \tag{5.6}$$

The reduction in the intra-tariff rates also has an effect on the conditional demands for the *M* good. Specifically, the demand for the varieties produced within the bloc will be equal in country 1 and 2, but these can be different from the ROW's demand for the intra-bloc varieties, i.e. $m_{1,1} = m_{2,2} \neq m_{3,3}$ and $z_{1,1} = z_{2,2} \neq z_{3,3}$. Similarly, there will be symmetry in the reciprocal imports between the CU partners, i.e. $m_{1,2} = m_{2,1}$ and $z_{1,2} = z_{2,1}$ as well as in their imports from the ROW, i.e. $m_{3,1} = m_{3,2}$ and $z_{3,1} = z_{3,2}$. Given the symmetry between the countries members of the union, demand from the ROW for their product will also be symmetric, i.e. $m_{1,3} = m_{2,3}$ and $z_{1,3} = z_{2,3}$. These allow us rewrite the consumer demand for the M good (4.10) as:

$$m_{1,1} = \left(\frac{Y_1}{P_{M,1}}\right)\left(\frac{p_1}{P_{M,1}}\right)^{-\sigma} \tag{5.7}$$

$$m_{2,1} = \left(\frac{Y_1}{P_{M,1}}\right)\left(\frac{(\tau - \varepsilon)\, p_1}{P_{M,1}}\right)^{-\sigma} \tag{5.8}$$

$$m_{3,1} = \left(\frac{Y_1}{P_{M,1}}\right)\left(\frac{\tau\, p_3}{P_{M,1}}\right)^{-\sigma} \tag{5.9}$$

$$m_{3,3} = \left(\frac{Y_3}{P_{M,3}} \right) \left(\frac{p_3}{P_{M,3}} \right)^{-\sigma} \tag{5.10}$$

$$m_{1,3} = \left(\frac{Y_3}{P_{M,3}} \right) \left(\frac{\tau p_1}{P_{M,3}} \right)^{-\sigma} \tag{5.11}$$

We then apply the same methodology to the demand for intermediates. These allow us to rewrite the firms' conditional factor demands for the *M* good (4.21) as:

$$z_{1,1} = \left(\frac{\gamma \beta \Omega_1 x_1^S}{P_{M,1}} \right) \left(\frac{p_1}{P_{M,1}} \right)^{-\sigma} \tag{5.12}$$

$$z_{2,1} = \left(\frac{\gamma \beta \Omega_1 x_1^S}{P_{M,1}} \right) \left(\frac{(\tau - \varepsilon) p_1}{P_{M,1}} \right)^{-\sigma} \tag{5.13}$$

$$z_{3,1} = \left(\frac{\gamma \beta \Omega_1 x_1^S}{P_{M,1}} \right) \left(\frac{\tau p_3}{P_{M,1}} \right)^{-\sigma} \tag{5.14}$$

$$z_{3,3} = \left(\frac{\gamma \beta \Omega_3 x_3^S}{P_{M,3}} \right) \left(\frac{p_3}{P_{M,3}} \right)^{-\sigma} \tag{5.15}$$

$$z_{1,3} = \left(\frac{\gamma \beta \Omega_3 x_3^S}{P_{M,3}} \right) \left(\frac{\tau p_1}{P_{M,3}} \right)^{-\sigma} \tag{5.16}$$

Clearly, the reduction in the intra-tariff rates also has an effect on the total supply of the *M* good from every country. Country 1 and country 2 supplies will be equal to each other but they may differ from that of ROW, i.e.: $x_1^S = x_2^S \neq x_3^S$. Using (4.25) and (5.7) to (5.16) then we can rewrite (4.27) as:

$$x_1^S = m_{1,1} + m_{1,2} + m_{1,3} + n_1 z_{1,1} + n_2 z_{1,2} + n_3 z_{1,3}$$

$$x_1^S = m_{1,1} + m_{1,2} + m_{1,3} + n_1 \left(z_{1,1} + z_{1,2} \right) + \left(n^w - 2n_1 \right) z_{1,3} \tag{5.17}$$

$$x_3^S = m_{3,3} + 2m_{3,1} + n_3 z_{3,3} + 2n_1 z_{3,1} \tag{5.18}$$

Then choosing the value of α, such that $\alpha = 1$, the firm zero-profit condition yields

$$r_1 = p_1 x_1^S - \beta \Omega_1 x_1^S \tag{5.19}$$

$$r_3 = p_3 x_3^S - \beta \Omega_3 x_3^S \tag{5.20}$$

where, r_1 is rate of return to capital from country 1 and country 2 and r_3 is rate of return to capital from the ROW.

Then, we have to modify households' income equations (4.3) to obtain:

$$Y_1 = L + 2\left(1 - t_1\right) r_1 K_{r,1} + \left(1 - t_3\right) r_3 K_{r,3} + TR_1 \tag{5.21}$$

$$Y_3 = L + 2\left(1 - t_1\right) r_1 K_{r,1} + \left(1 - t_3\right) r_3 K_{r,3} + TR_3 \tag{5.22}$$

where, Y_1 is households' income in country 1 and country 2 and Y_3 is households' income in the ROW, respectively; L is labour endowment, which we assume to be the same in all countries; $K_{r,1}$ is the amount of investment in either country in the bloc[21] from any of the three countries; and $K_{r,3}$ is the amount of investment in the rest of the world from any of the three countries. The allocation of capital across countries is determined by the functions of the relative net rate of return to capital:

[21] Strictly speaking, this is the investment in country 1. For ease of exposition, in what follows we discuss the model in terms of country 1 and country 3 only – all equations for country 2 are analogous to those for country 1.

$$K_{r,1} = K_1\left(\frac{\left(\left(1-t_1\right)r_1\right)^{\psi}}{2\left(\left(1-t_1\right)r_1\right)^{\psi}+\left(\left(1-t_3\right)r_3\right)^{\psi}}\right) \tag{5.23}$$

$$K_{r,3} = K_3\left(\frac{\left(\left(1-t_3\right)r_3\right)^{\psi}}{2\left(\left(1-t_1\right)r_1\right)^{\psi}+\left(\left(1-t_3\right)r_3\right)^{\psi}}\right) \tag{5.24}$$

Noticeably, households' income in country 1 and country 2 (5.21) and households' income in country 3 (5.22) only differ in the last term in the RHS of both equations. TR_1 and TR_3 , respectively, are government transfers from countries in the bloc and the rest of the world, which arise from both import tariff and CIT revenues and are redistributed to consumers in a lump-sum fashion. Using (4.33) and (4.34) we can rewrite the government transfer equation as:

$$TR_1 = \left(\tau-\varepsilon-1\right)n_1p_1\left(m_{2,1}+n_1z_{2,1}\right)+\left(\tau-1\right)n_3p_3\left(m_{3,1}+n_3z_{3,1}\right)+t_1r_1\sum_{s=1}^{3}K_{s,1}$$

$$\begin{aligned} TR_1 = {} & \left(\tau-\varepsilon-1\right)n_1p_1\left(m_{2,1}+n_1z_{2,1}\right)+\left(\tau-1\right)\left(n^w-2n_1\right)p_3m_{3,1} \\ & +\left(\tau-1\right)\left(n^w-2n_1\right)^2p_3z_{3,1}+t_1r_1\sum_{s=1}^{3}K_{s,1} \end{aligned} \tag{5.25}$$

$$TR_3 = \left(\tau-1\right)2n_1p_1\left(m_{1,3}+n_1z_{1,3}\right)+t_3r_3\sum_{s=1}^{3}K_{s,3} \tag{5.26}$$

Finally, given that $\alpha=1$, the capital market clearing condition equation (4.29) can be rewritten as:

$$\sum_{s=1}^{3}K_{s,r} = n_r \tag{5.27}$$

5.3 Agglomeration and dispersion after a Customs Union formation

In our analysis, the objectives of the government are to raise consumers' welfare by implementing a policy that aims to attract capital into the country; given the model set-up, this implies that the policy will ultimately determine the total capital available for production, and in turn, the number of firms operating in the country. The policy instrument we considered in this section is the tariff rate $\tau_{s,r}$. Table 5.1 shows the direction of change in endogenous variables due to changes in exogenous parameters.

When governments use the tariff rate as a policy to attract capital into the country, such policy would transmit its effects through several important channels, i.e.:

(i) A change in the CES price index. From 5.8 and 5.13, an intra-tariff reduction directly causes demands for imported varieties of the *M* good from another CU country $m_{s,r}$ and $z_{s,r}$ ($s \neq r$ and $r \in \{1,2\}$) to increase. On the other hand, (5.7), and (5.9) to (5.12) and (5.14) to (5.16) state that an intra-tariff reduction has no direct effect on the demand for varieties that are either domestically produced or imported from the ROW. From (5.3), a decrease in intra-tariff rate will directly cause both CU countries' CES price indices, $P_{M,1}$ and $P_{M,2}$, to fall. Since both CES price indices in CU countries decrease, the final demand for total *M* good consumption in the CU area has to increase to keep the total expenditure constant. However, from (5.7) to (5.9) and (5.12) to (5.14), a decrease in price indices in both CU countries would

partially offset an increase in the demands for all varieties consumed in both CU countries $m_{s,r}$ and $z_{s,r}$ (where $s \in \{1,2,3\}$ and $r \in \{1,2\}$). As a result, demands for imported varieties of the *M* good from another CU country, $m_{s,r}$ and $z_{s,r}$ ($s \neq r$ and $r \in \{1,2\}$) would increase and dominate a decrease in the demands for domestically produced varieties, $m_{s,r}$ and $z_{s,r}$ where $s = r$ and $r \in \{1,2\}$, and a decrease in the demands for imported varieties from ROW, $m_{3,r}$ and $z_{3,r}$ where $r \in \{1,2\}$.

(ii) A change in prices. From (5.5), a decrease in CU countries' CES price indices, $P_{M,1}$ and $P_{M,2}$ would result in a decrease in CU countries' variable input price indices, Ω_1 and Ω_2. From (5.1), a decrease in variable input price indices in both CU countries will cause a decrease in typical *M* good prices in the CU countries, p_1 and p_2. This will raise the demands for all *M* good produced in both CU countries, $m_{s,r}$ and $z_{s,r}$, where $s \in \{1,2\}$ and $r \in \{1,2,3\}$. A reduction in *M* good varieties' prices in the CU countries has recursive effects by causing further decreases in both CU countries' CES price indices. These would in turn slightly reduce the demands for varieties consumed in CU countries $m_{s,r}$ and $z_{s,r}$ ($r \in \{1,2\}$ and $s \in \{1,2,3\}$). However, with the migration of firms from ROW into the CU, a decrease in individual variety prices in the CU countries may result in an increase in ROW's price index, $P_{M,3}$, which in turn will (via backward linkages) cause

varieties' prices in the ROW to increase and eventually lead to a decrease in the demand for the *M* good from the ROW. A decrease in CU countries' variable input price indices, Ω_1 and Ω_2, would also results in lowering variable cost of production within CU area. From (5.19), since a typical *M* good price is a fixed mark up on variable cost, an increase in the demands for the *M* good produced in both CU countries would increase the rate of return to capital from firms operating in both CU countries. From (5.4) and (5.6), a decrease in *M* good prices in CU countries and the migration of firms from the ROW would result in an increase in ROW's variable input price indices, Ω_3. This, eventually, results in a decrease in the rate of return to capital from firms operating in the ROW.

(iii) A reallocation of firms across countries. The disparity between the rates of return to capital in the CU countries and in the ROW would induce firms to relocate from the ROW to CU countries. Firms' relocation would cause reductions in individual variety prices and CES price indices in both CU countries. Unlike consumers, who are internationally immobile and are confined to spend their income in their home country, firms can relocate across countries and carry their expenditures on intermediates to the host country. Firms' relocation would increase total expenditure on the *M* good in the CU area, while decreasing it in the ROW. Firms' relocation also causes an increase in both individual variety prices and CES price index in the ROW. This process will further strengthen an increase in the demands for varieties of the *M* good produced in CU countries, but weaken the demands for

varieties produced in the ROW. However, as new firms migrate into the CU area, the effect on the gap between rates of return to capital is ambiguous. This would depend on the level of vertical linkages. Generally, the gap between rates of return to capital would decrease, if the level of vertical linkages is low. However, the gap between rates of return to capital may widen, if the level of vertical linkages is sufficiently high.

(iv) A change in government transfers. As intra-tariff reduction incentivizes firms to relocate to the CU area, it would result in a reduction of government income from tariff, via a fall of tariff revenue from both intra-CU imports (that are no longer taxed) and imports from the ROW, as the number of firms in the ROW has fallen. Consequently, via this channel, the nominal incomes of consumers in CU countries would decrease as the government transfer falls ceteris paribus. However, consumers' real incomes are likely to increase, as the consumer price indices decrease at the higher rate. Consumers in the ROW would experience the opposite. Their nominal income would increase from higher government's transfers, since the revenue from import tariffs would increase, as consumers and firms have to rely more on imported goods. Their real incomes are also likely to increase, as the consumer price indices increase at the lower rate.

As is suggested by Baldwin et al.(2003), the interaction of forward linkages, backward linkages and market crowding effects in this model result in a disparity among the rates of return to capital across countries. The differences among the rates of return to capital, in turn, induce a relocation of investment from the ROW to CU

countries. Market crowding effects will act as a dispersion force and work towards stabilizing the equilibrium. The emergence of dispersion forces – or market crowding effects – happens when the market shares of existing firms fall as a result of new firms moving into a market at an unchanged market size. This leads the operating profit of all incumbent firms in the market to fall, thus giving rise to a disincentive for a new firm to move into a CU countries' market. Therefore, the market crowding effect usually works towards firms to relocate to the ROW market, which has less competitive environment. Agglomeration forces, which consist of forward and backward linkages, in contrast, work in favor of destabilizing the equilibrium. Forward linkages effect attracts firms to relocate to CU countries where the price of intermediate inputs is lower. Generally, sourcing the intermediate inputs from domestic suppliers lowers the cost of production relative to using supplies from overseas, which are subject to an import tariff. Thus, other things equal, the stronger the agglomeration of firms, the lower the cost of production is in the region that experiences the agglomeration. Agglomeration of firms will also lead to an increase in total expenditure on the *M* good in the CU countries. Then backward linkages effect starts attracting more firms to relocate to the CU area. The more the firms agglomerate the larger the total expenditure is; the formation of a CU instantaneously generates forward linkages effects that attract new firms to move into the CU area. After new firms start relocating, backward linkages and market crowding effects are generated. Thus, the combination of market crowding effects, forward and backward linkages will result in the difference between the rates of return to capital from CU countries and the ROW. If the difference is positive, investors will be willing to move their investment into CU countries – and firms will relocate there. Multiple

equilibria will typically exist, with both a partial agglomeration and a catastrophic agglomeration as possible outcomes.

Agglomeration in this model crucially depends on the existence of forward and backward linkages which result in the emergence of circular causality and self-reinforcing processes of agglomeration. The strength of the agglomeration forces depends on two key parameters: the level of market integration (captured by the size of the trade cost τ), and the strength of the vertical linkages – determined by the share of firms' total cost accounted for by intermediate inputs γ. The presence of vertical linkages among firms in the *M* sector, which results from the expenditure on intermediate goods, is one of key mechanisms underpinning agglomeration. With firms' mobility across countries, the vertical linkages are the main trigger of agglomeration; when there is no labour migration, expenditure from labour income does not differ much between countries. Thus, the level of γ is crucially important in this model. Vertical linkages generate demand for intermediate goods. This, in turn, induces cost minimising firms to relocate to the agglomerated region, which allows them to use the low-priced domestically produced intermediate goods. The higher the level of γ the stronger is the incentive for firms to agglomerate in one location.

For a given level of vertical linkages, γ, a tariff, τ, makes consumers perceive imported goods as being more expensive than domestic goods. This causes consumers to spend relatively more on domestic goods than on imported goods. However, a tariff is different from an iceberg trade cost (typically considered in new economic geography models) because a tariff is a source of government revenue that, in our model, is transferred directly to the consumers and hence feeds back into total expenditure. Nevertheless, the more firms move into a country, the lower is the tariff

revenue and the government transfer. Generally, as in the standard iceberg trade cost model, if agglomeration occurs in any country, the CES price index in that country will be lower relative to the price index in other countries. However, at low level of trade cost, firms will not derive sufficient benefits from agglomeration in one location – as agglomeration in that instance has a small effect on the cost of production via a reduction of the composite variable input price index Ω. At intermediate levels of τ, the agglomeration forces becomes significant. The larger the number of firms that gathers in the country, the lower the cost of production – and this effect is significant at intermediate levels of τ. Finally, at high levels of τ, consumers and firms will spend significantly more on domestically produced varieties than on imported ones. This makes domestic revenue for firms more important than export revenue.

Clearly, after the formation of a CU, another crucially important factor in determining the reallocation of firms across national borders is the reduction in intra-tariff, ε. This factor creates both agglomeration and dispersion forces in the CU area. Therefore, we shall look at how each main factor affects agglomeration and dispersion forces in the following sections.

5.4 The criteria for policy implementation

In order to assess whether a Preferential Trade Agreements is a feasible policy instrument – that serves the objective of the government to attract investments into the country and, eventually, raise social welfare, we will assess the effects of PTA formation using three indicators. These indicators are:

(i) The ratio of firms that locate in the country to the total number of firms in the world. In our model, the number of firms operating in

each country is perfectly correlated with total investment. Therefore, we can use the ratio of firms that locate in the country to the total number of firms in the world to assess whether PTA formation attract investments into the country.

(ii) The change in social welfare. To assess whether a PTA formation raises social welfare, we can either compare ex-post and ex-ante indirect utility or utilize a standard Equivalent Variation (EV) method to measure the welfare effects of PTA formation. These two indicators closely relate to each other. EV is indeed the difference between ex-post and ex-ante indirect utility adjusted by ex-ante consumer price index. EV measures the change in income caused by the PTA formation, given the price of the pre-PTA period; thus, it measures how much a change in income at the current price is needed for consumers to attain the level of utility that they would receive from the proposed policy changed. We can decompose both indirect utility and EV to see the welfare effects from different sources of income. However, it is not simple to extract the welfare effect of changes in prices from indirect utility. Therefore, we choose EV as an indicator to measure the welfare effects of PTA formation. Then, EV can be expressed as:

$$EV_r = \frac{Y_r^1}{P_{M,r}^{\Delta}} - Y_r^0 \qquad (5.28)$$

Where Y_r^0 and Y_r^1 are the pre- and after- policy change levels of income respectively. $P_{M,r}^{\Delta}$ is the ratio of the post to pre- policy change CPI, which can be expressed as:

$$P_{M,r}^{\Delta} = \left(\frac{P_{M,r}^{1}}{P_{M,r}^{0}} \right)^{\mu} \tag{5.29}$$

Then we can rearrange (5.28) as:

$$EV_r = \frac{Y_r^1 - Y_r^0}{P_{M,r}^{\Delta}} + \left(\frac{1}{P_{M,r}^{\Delta}} - 1 \right) Y_r^0 \tag{5.30}$$

The first term on the right-hand-side is a real income effect, given by the change in nominal income deflated by the CPI ratio. The second term is a consumer surplus effect, which is the effect of changes in price on welfare. According to (4.3), consumers have income from three sources viz. labour, capital and government transfers. Accordingly, we can decompose the real income effect into three different effects. In doing so, we rewrite the real income effect component in (68) as:

$$EV_r = \frac{\left(wL_r + \sum_{s=1}^{3} r_s^1 K_{r,s}^1 + TR_r^1 \right) - \left(wL_r + \sum_{s=1}^{3} r_s^0 K_{r,s}^0 + TR_r^0 \right)}{P_{M,r}^{\Delta}} + \left(\frac{1}{P_{M,r}^{\Delta}} - 1 \right) Y_r^0 \tag{5.31}$$

where r_s^0, $K_{r,s}^0$ and TR_r^0 are the benchmark (i.e. pre-CU formation) return to capital, amount of investment and government transfer, respectively; r_s^1, $K_{r,s}^1$ and TR_r^1 are the return to capital, amount of investment and government transfer after the proposed policy, respectively. However, the number of units of labour is fixed and the

wage rate is normalized to 1. Therefore, labour income will not affect the change in welfare. Then we can express (5.31) as:

$$EV_r = \left(\frac{\sum_{s=1}^{3} r_s^1 K_{r,s}^1 - \sum_{s=1}^{3} r_s^0 K_{r,s}^0}{P_{M,r}^{\Delta}} \right) + \left(\frac{TR_r^1 - TR_r^0}{P_{M,r}^{\Delta}} \right) + \left(\frac{1}{P_{M,r}^{\Delta}} - 1 \right) Y_r^0 \quad (5.32)$$

The first term on the right-hand-side of 5.32 is a capital income (KI) effect. The second term is a government transfer (TR) effect. The third term is a consumer surplus (CS) effect.

(iii) Trade creation or trade diversion[22]. Apart from the two previous indicators, we also need to assess whether the PTA formation results in trade creation or trade diversion. Viner (1950) showed that the formation of a CU may lead to trade diversion. Trade diversion generates inefficiency in world production. It may also hurt member countries, if the gain from the agreements is too small to outweigh the costs arising from the inefficiency.

The first two indicators will be used, particularly, by the governments to decide whether the countries should commit to the preferential trade agreements. Since we assume that the governments are benevolent, a PTA formation will be a feasible policy instrument if and only if it leads to country level welfare gain – assessed by indicator (ii). On the other hand, indicator (iii) will be used to assess the effects of PTA formation not only on each country economy but also on the world economy.

[22] Trade creation is generally thought to be welfare enhancing, while trade diversion is considered as being welfare reducing. Trade creation occurs if PTA member countries replace their consumption from inefficient domestic suppliers with goods produced by more efficient producers in other member countries. On the other hand, trade diversion occurs if PTA member countries replace their consumption from more efficient suppliers in non-member countries by less efficient producers in other member countries. Freund and Ornelas (2010, Krueger (1997)

5.5 Simulations of the economic impacts of the preferential trade agreements

Under the WTO, international trade is regulated by the most favored nation (MFN) practices, in which member countries may not discriminate against goods entering their borders based upon the country of origin. Nevertheless, under Article XXIV, WTO members are allowed to enter into preferential trade agreements under the conditions that (i) tariffs cannot remain applicable for any part of the intra-PTA trade (ii) preferences cover substantially all aspects of trade, and (iii) tariffs on external trade with non-CU members are not raised (Krueger, 1997). However, article XXIV does not clearly specify the process of intra-tariffs elimination. Consequently, we regularly see many countries enter a PTA and choose to phase out rather than instantaneously eliminate their intra-PTA tariffs.

In this section, we examine the effects of different types of PTA formation – i.e. CU and FTA - on the location of firms and on consumers' welfare. We conduct the experiment as follows. To start with, Country 1 and Country 2 form a PTA by implementing a simultaneous reduction of the intra-PTA tariff rates, while the tariffs on external trade with non-members are not raised. To examine the effects of the formation of a PTA, we shall simulate the intra-PTA tariff reduction at different levels of external tariff rates (ranging from low to prohibitively high). The simulations in the first two parts of this section are carried out under the assumption that countries are symmetric in size and technology.[23] We then relax this assumption and analyse the impacts of PTA formation when countries are asymmetric.

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[23] We choose the following values of exogenous variables and parameters: $L_r = 100$, $K_r = 100$, $\alpha = 1$, $\beta = (\sigma - 1)/\sigma$, $\gamma = 0.60$, $\mu = 0.75$, $\sigma = 8$ and $\psi = 5$.

When modelling the PTA formation, two conditions specified by article XXIV of GATT/WTO need to be considered i.e.: (1) Member countries remove barriers on all trade between PTA members,and (2) the external tariffs imposed after the formation of PTA must be no higher than those that were in force beforehand. In the literature that studies the effects of PTA formation (both CU and FTA), the common assumption concerning the first condition is that the internal tariffs are set to zero. On the other hand, two alternative approaches are regularly used to fulfil the second condition. The first approach is that the pre-PTA tariffs continue to apply to imports from the rest of the world (see, e.g., Grossman and Helpman (1995), Panagariya and Krishna (2002)). The second approach is that the optimal external tariffs are endogenously chosen by member countries (see, e.g.: Kennan and Riezman (1990), Krugman (1991b)).The use of the terms “CU” and “FTA” in this thesis ensures that the first condition is satisfied, while the CU and FTA, for simplicity, are assumed to apply the initial tariffs to imports from the rest of the world and not to optimize their use of external tariffs. Therefore, this makes the present exercise basically different from what is found in the literature that uses optimal tariffs approach.

5.5.1 The effects of the formation of a PTA between symmetric countries

In this section we examine the different effects of each type of PTA formation. Specifically, we consider two types of PTA – that is: **(i)** the formation of a Customs Union (CU); and **(ii)** the formation of a Free Trade Agreements (FTA). For simplicity, we assume that all countries are symmetric in size and technology. We will carry out a simulation of a partial reduction and eradication of intra-PTA tariff at different levels of external tariff rates (ranging from low to prohibitively high). In the

first case, we shall further assume that countries' initial levels of import tariffs are the same, while in the second case we shall assume that countries' initial level of import tariffs are different.

5.5.1.1 The effect of the formation of a CU

We begin the analysis with the simplest type of PTA formation − which is the formation of a CU between country 1 and country 2 that are assumed to be symmetric in size, technology as well as the initial level of tariffs on trade with other countries. The effects of the formation of a CU between symmetric countries on member countries and the ROW can be summarised as follows:

- A reduction of intra-CU tariff causes an instantaneous reduction in the CES price indices and, consequently, causes a reduction in the variable input price indices and in the prices of individual varieties in both CU countries. Thus the formation of a CU creates forward linkages effects that incentivize firms to relocate to CU markets where the price of intermediate inputs is lower.
- The forward linkages effect causes firms in CU countries to yield a higher rate of return to capital than firms in the ROW. The disparity between CU countries' and the ROW's rates of returns induces firms to relocate from the ROW to CU countries. The more the firms agglomerate the larger the expenditure on *M* good is. This would trigger a backward linkages effect – which further attracts additional firms to relocate to CU countries.
- The emigration of firms from the ROW, on the other hand, directly causes an increase in the CES price index and consequently an increase in individual variety prices in the ROW. It also causes a reduction in

total expenditure on the *M* good. The conjunction of emigration of firms and the reduction of individual variety prices in CU countries would raise the ROW's demand for varieties of the *M* good imported from CU countries. Accordingly, the ROW government's import tariff revenues would increase. Consequently, via this channel, the nominal incomes of consumers in the ROW would increase as government transfers rise ceteris paribus. However, the effect on consumers' welfare is ambiguous, and depends on the level of external tariff rates.

When country 1 and 2 eradicate intra-CU tariffs on intra-CU trade, the CU formation affects the change in welfare on both CU member countries and the ROW. We decompose the effect of a PTA formation on welfare changes into three different effects: the capital income effect, the government transfer (TR) effect and the consumer surplus (CS) effect. Figure 5.1 shows the impact of these three effects on CU countries as follows:

- An increase in welfare in CU countries mainly results from a CS effect, which is directly caused by a decrease in consumer price indices in both CU countries. The change of the level of welfare induced by a CS effect occurs at a decreasing rate as the external tariff increases.
- A change in capital income has only a slight effect on total welfare. Specifically, it has a small positive effect when the external tariffs are at low and intermediate levels. However, its effect becomes negative when the external tariffs are sufficiently high. As a consequence of CU formation, which transmits its effect through a relocation of firms across countries, rates of return to capital of firms operating in CU countries increase slightly regardless of the levels of external tariff

rates. On the other hand, rate of returns in the ROW moderately fall, when the external tariff rates are low, or fall substantially, if the external tariff rates are at intermediate, high and prohibitively high levels. Not only does the net effect of a change in capital income on total welfare depend on a difference between rates of return in CU countries and the ROW, but it also depends on the extent of firms' relocation. After a CU formation, the bulk of firms agglomerate in CU area, when the external tariff rates are at intermediate and high levels. Instead, firms do not agglomerate in the CU area when the external tariff rates are at low and prohibitively high levels. As a consequence, a change in capital income generates a small positive effect, where the total gain from the returns to capital by firms operating in CU area outweighs the total loss from returns to capital experienced by the remaining firms in the ROW – if the external tariffs are at low and intermediate levels. However, its effect becomes negative when the external tariffs are sufficiently high and the total loss from returns to capital by firms locating in the ROW outweighs the total gain from returns to capital by firms operating in CU area.

– Relatively higher prices of individual varieties from the ROW − which are additionally subject to import tariff – and a relocation of firms cause a drastic reduction of imports from the ROW. This, in turn, results in a reduction of tariff revenue and government transfers. For CU countries, a reduction in government transfers – TR effect − has a considerable negative effect on welfare, thus partially crowding out the CS effect. The decrease in government transfer is largest where the external tariff

rates are at intermediate levels and firms fully agglomerate in CU countries.

However, as can be seen from Figure 5.2, a decomposition of the three different effects on welfare change in the ROW shows a different pattern to that of CU countries:

- A change in capital income has only a slight effect on total welfare, which is almost identical to that of CU countries.
- The change of the level of welfare mainly originates from the interaction between a positive CS effect and a negative TR effect.
- At low levels of external tariffs, the ROW's consumers experience welfare losses because a considerable negative TR effect outweighs a positive CS effect.
- Then, the change in welfare turns out to be positive at intermediate levels of external tariffs, because a negative TR effect is lower than a sizeable positive CS effect.
- However, the TR effect turns out to be positive when the external tariff rates are sufficiently high. Thus, at high external tariffs, the ROW's welfare gain is the result of both positive CS and TR effects.
- At prohibitively high levels of external tariffs, the CS effect is negative in the ROW. However, at this range of external tariffs, the total change in welfare is positive, which is mainly caused by a TR effect.

Figure 5.3 and 5.4 illustrate the change in welfare in CU countries and the ROW that result from three different levels of intra-CU tariffs reduction, namely: full eradication, a 75% reduction, and a 50% reduction. Generally, a reduction of intra-CU tariffs causes welfare in both CU countries to increases as the intra-CU tariff

rates fall. The higher the external tariff rate, the larger the welfare increases. However, welfare increases until it reaches its peak when the external tariffs are at high or prohibitively high levels. If we compare the effects of eradication and partial reduction of intra-CU tariffs, we find that the larger the reduction of intra-CU tariffs, the higher are the welfare increases.

On the other hand, intra-CU tariff eradication will be more harmful than a partial reduction to the ROW, if the external tariffs are very low. At this level of tariff rates, such policy creates a strong negative TR effect, which a positive CS effect is not sufficient to compensate. However, a partial intra-CU tariff reduction would create a weaker negative TR effect, through a smaller reduction in price p_1 as well as a smaller number of firms relocating. However, this negative TR effect is still larger than a positive CS effect. Therefore, the total effect still cause welfare loss in the ROW, but the total welfare loss is smaller than the one resulting from a total intra-CU tariff eradication policy. As the external tariffs increase to an intermediate level, a total intra-CU tariff eradication policy is less harmful to the ROW. This is because the CS effect is stronger. Then, the ROW benefits from welfare gains as a result of CU formation, where the external tariffs are sufficiently high. At this level of tariffs, a positive TR effect is substantial and sufficient to cover the loss of welfare by capital income effects and/or CS effects.

Figure 5.5 and 5.6 show the ratios of the number of firms operating in country 1 and in the ROW to the total number of firms in the world for three different levels of intra-CU tariffs reduction: eradication, a 75% reduction, and 50% reduction. Specifically, we find that full agglomeration in CU countries occurs at intermediate levels of the external tariff. We also find that the larger the reduction of intra-CU tariffs, the more firms agglomerate in CU countries. At the low and prohibitively

high levels of external tariff rates, market crowding effect is sufficiently strong to deter all firms to fully agglomerate in CU countries.

Finally, we assess whether the PTA formation results in trade creation or trade diversion. In doing so, we examine the change in prices of individual varieties and the change in demands on the *M* good after an eradication of intra-CU tariffs, as shown in figure 5.7 and 5.8, respectively. The results can be summarized as follows:

- Prices of individual varieties produced in both CU countries decrease, after a CU formation. Generally, the higher the level of external tariffs, the larger fall in prices.
- On the other hand, prices of individual varieties produced in the ROW slightly decreases, when the external tariffs are at low, intermediate and high level. However, these prices increase as the external tariffs are prohibitively high.
- Total demand in each CU country rises as a result of a change in the CES price indices and prices of individual varieties.
- At low and intermediate levels of external tariffs, the increases in total demand in each CU country consists of a substantial increase in demands on the *M* good produced in another CU country as well as an increase in demands on domestically produced varieties – even though the latter is smaller and converges to its initial level as the external tariff rates increase. Increasing demands on the *M* varieties produced in CU countries also offset decreasing demands on the *M* good produced in the ROW.
- At high and prohibitively high levels of external tariffs, increasing total demand in each CU country only originates from a substantial increase

in demands on the *M* good produced in another CU country. Increasing demands on the *M* good produced in another CU country outweigh decreasing demands on both the varieties produced domestically and in the ROW.

- It is clearly seen from figure 5.7 and 5.8 that the formation of a CU between symmetric countries results in trade creation, since member countries replace their demands from inefficient suppliers by more efficient producers in other member countries.

For CU countries, an instantaneously eradication of intra-CU tariff is a dominant policy − in term of both indicators (i) and (ii) – as it attracts the highest number of firms to the CU countries as well as yields the highest welfare gain to CU's countries. Both total and partial intra-CU tariff reduction policies yield similar results: as the external tariff rate increases, these policies attract investments into CU countries until most of the firms agglomerate in the CU. At intermediate external tariff rates, firms almost fully agglomerate in the CU countries. The allocation of firms will converge to the dispersed equilibrium as the external tariff increases to the prohibitively level. The magnitude of firms' agglomeration depends on the level of intra-CU tariff reduction. The deeper the intra-tariff reduction the stronger is the backward linkages effects. Hence, the higher number of firm agglomerates together. The formation of a CU between symmetric countries also yields trade creation. Finally, an instantaneous eradication of intra-CU tariff policy is Pareto improving, if the external tariffs are sufficiently high. Otherwise, such CU formation policy results in increasing welfare in CU countries at the expense of the ROW.

5.5.1.2 The effects of the formation of a FTA between symmetric countries

In this section we examine the effect of FTA formation. In doing so, we have to amend our assumptions such that countries' initial level of import tariffs are different. For simplification, we assume that there are two groups of countries – i.e. a low tariffs group and a high tariffs group. Let country 1 be a low tariff country and country 2 and 3 be high tariff countries – which we assume $\tau_{s,r} = \tau_{s,1} + 0.1,\ r \in \{2,3\}$, $s \in \{1,2,3\}$, and $r \neq s$. The formation of a FTA is between country 1 and country 2, which we assume to be symmetric in size and technology[24]. After the FTA formation, member countries keep their initial level of tariffs on trade with the ROW.

By using this setup, a number of specific issues that affect the welfare consequences of FTA formation can be examined. Specifically, one of the most common issues is the need for rules of origin (RoOs) in FTAs to prevent the trans-shipment of imported goods from a low-tariff country to a high-tariff country. The RoOs can be seen as another type of non-tariff barrier to intra-FTA trade; for example, Herin (1986) suggested that the cost of obtaining the necessary documents to prove the origin of goods in the context of EFTA have been variously estimated at 3-5 percent of f.o.b. price. However, we shall not cover this issue here. The interested reader is referred to Estevadeordal and Suominen (2005) for details of the criteria employed, and Grossman (1981), Ju and Krishna (2005), Krishna and Krueger (1995), Krueger (1999) Richardson (1995) and Vousden (1987) for its effect.

[24] As argued by Brander and Spencer (1984), if international markets are imperfectly competitive, then firms in these markets may earn pure profit. Protection can shift some of this profit from foreign to domestic firms as well as increase government revenue. Therefore, from a purely domestic point of view, protection may be an attractive policy. Therefore, in the case in which the two countries are symmetric, the different pre-PTA tariffs might have arisen because of the difference between ideological stances of the governments or the lobbying activities of the domestic industry. Additionally, this set up of the pattern of pre-FTA tariffs is common in the literature; see, e.g.: Grossman and Helpman (1995),Bhagwati and Panagariya (1996),Panagariya and Krishna (2002).

The effects of a FTA formation on the allocation of firms in country 1 and the ROW are comparable to those obtained for CU countries and the ROW from the analysis of a CU formation in the previous subsection. On the other hand, the effect of FTA formation on the allocation of firms in country 2 is different. The difference is due to the allocation of firms prior to the FTA formation, which is shown in figure 5.9 – 5.11:

- Prior to the FTA formation, firms earn higher profit from choosing to produce in higher tariffs countries and export to lower tariffs countries, particularly, when the external tariff rates are at intermediate level.
- The formation of a FTA creates forward linkages effects that incentivise firms to relocate to country 1 and 2, where the price of intermediate inputs is lower. The agglomeration of firms would also create a backward linkages effect. The more firms agglomerate the larger the backward linkages effect is. The backward linkages effect would further attract additional firms to relocate to FTA member countries − where the total expenditures are larger than the ROW.
- The relocation of firms into country 1 and 2 depends on the level of intra-FTA tariffs reduction. The deeper the intra-tariff reduction is, the stronger are backward linkages effects. Hence, a larger number of firm agglomerates in FTA countries.
- However, a partial intra-FTA tariff reduction creates spatial inequality between FTA member countries. Country 2 is also likely to lose firms in this scenario, particularly when external tariffs are at intermediate and high levels. Specifically, a partial intra-FTA tariffs reduction

potentially leads to an internal catastrophic agglomeration[25] (or a 'two-tier home-market effect') – in which all firms agglomerate in country 1 which has lower external tariffs, as shown in figure 5.9 and 5.10. This phenomenon occurs mainly due to forward linkages effects – with firms benefiting from lower cost of production by choosing to relocate to a lower tariffs member country. In particularly, an internal catastrophic agglomeration occurs when intra-FTA trade is sufficiently free. However, it does not occur when intra-FTA trade is either perfectly free or subject to high intra-FTA tariffs. In our simulations, if member countries simultaneously apply a 75% intra-FTA tariffs reduction, an internal catastrophic agglomeration occurs when the external tariffs are at intermediate, high and prohibitively high level. However, it neither occurs when member countries choose to apply 50% intra-FTA tariffs reduction nor eradicate their intra-FTA tariffs. This two-tier home-market effect is similar to that of suggested by Puga and Venables (1997) and Baldwin (2003) – that is, as long as intra-FTA trade is not perfectly free, firms tend to move towards the larger country inside the bloc.

– Considering the case where firms do not relocate immediately after the formation of a FTA, the reduction of intra-FTA tariffs alone would cause individual variety prices of the *M* good in the ROW to become relatively higher than those of FTA countries. This brings about a reduction of demand for the varieties of the *M* good produced in the ROW. This effect would work towards shrinking the market size for

[25] This is the term used by Baldwin et al. (2003) to refer to catastrophic agglomeration that occurs in one member country within CU area.

firms operating in the ROW. Consequently, firms in the ROW will face increasing competition that triggers the dispersion forces or the market crowding effects in the ROW. As a result, these dispersion forces generate an incentive for some firms to emigrate from the ROW.

- The emigration of firms from the ROW further causes an increase in the CES price index and consequently an increase in individual variety prices in the ROW. It also causes a reduction in the ROW's total expenditure on the *M* good. These, again, strengthen the dispersion forces and incentivise additional firms to relocate to FTA countries, as shown in figure 5.11.

The effects of FTA formation on welfare in the FTA countries and in the ROW are also comparable to those obtained from the CU formation in the previous section. However, country 1 has the highest benefit from the FTA formation. The differences in the level of welfare changes are due to the allocation of firms prior to the FTA formation, which is shown in figure 5.12– 5.14:

- Generally, a reduction of intra-FTA tariffs causes welfare in both FTA countries to increases as the intra-FTA tariff rates fall. Welfare increases until it reaches its peak, when the external tariffs are at high level. If we compare the effects of eradication and partial reduction of intra-FTA tariffs, we find that the higher the reduction of intra-FTA tariffs, the larger the welfare increases.
- An intra-FTA tariffs eradication policy is less harmful to the ROW than a partial intra-FTA tariffs reduction. The ROW suffers from welfare loss, if the external tariffs are low. As the external tariffs increase to its intermediate level, an intra-FTA tariff reduction policy is less harmful

to the ROW. Then, the ROW may benefit from the welfare gain as a result of FTA formation, where the external tariffs are sufficiently high.

- In the FTA formation, intra-FTA tariffs eradication is no longer a dominant policy in term of welfare gain to FTA countries. In our simulation, a 75% intra-FTA tariffs reduction yields country 1 a higher level of welfare gain − at the expense of country 2 – than intra-FTA tariffs eradication. This phenomenon occurs because of an internal catastrophic or a two-tier home-market effect – in which all firms agglomerate in country 1 which has lower external tariffs.
- Since the FTA formation under Article XXIV governs that tariffs cannot remain applicable for any part of the intra-PTA trade, the benefit from higher welfare gain − in this case − may give an incentive for a low tariff member country to choose policies that do not result in the reduction of other types of trade costs for intra-FTA trade. Such policies may have an adverse effect on public goods or infrastructures, which are supposed to reduce trade costs, or on ones that generate other non-tariff barrier trade costs.

The decomposition of the effect of FTA formation on welfare changes in country 1, country 2 and the ROW are shown in figure 5.15 to 5.17, respectively:

- A change in capital income has only a slight effect on total welfare. Moreover, every country displays a similar pattern of change in welfare from capital income effect.
- An increase in welfare in FTA countries mainly results from CS effects, which are directly caused by a decrease in consumer price indices in both FTA countries.

- For FTA countries, a reduction in government transfers has a considerable negative effect on welfare, thus partially crowding out the CS effect.
- A low tariffs member country has larger welfare gains from CS effect but larger welfare loss from TR effects than a high tariffs member country.
- In the ROW, the change of welfare mainly originates from an interaction between a positive CS effect and a negative TR effect, particularly when the external tariff rates are at a low level.
- At low levels of external tariffs, the ROW's consumers suffer from welfare losses because a considerable negative TR effect outweighs a positive CS effect.
- Then the TR effect is positive, while the CS effect is negative at intermediate levels of external tariffs. Total welfare changes are positive when the external tariff rates are sufficiently high.

Finally, we assess whether the FTA formation results in trade creation or trade diversion. We examine the change in prices of individual varieties and the change in demands for the *M* good in country 1 and 2 after eradication of intra-FTA tariffs, as shown in figure 5.18 to 5.20, respectively:

- Prices of individual varieties produced in both FTA countries decrease, after a FTA formation. Generally, the higher the level of external tariffs, the larger the prices decrease. Moreover, prices in low external tariffs country decrease further than prices in high external tariffs country.

- On the other hand, prices of individual varieties produced in the ROW slightly decreases when the external tariffs are low and slightly increase, when the external tariffs are at intermediate and high levels.
- Total demand in each FTA country rises as a result of a change in the CES price indices and prices of individual varieties.
- At low and intermediate levels of external tariffs, the increase in total demand in country 1 consists of a substantial increase in demands on the *M* good produced in another FTA country as well as an increase in demands on domestically produced varieties of the *M* good – even though the latter is larger and returns to its initial level as the external tariff rates increase. However, decreasing demands on the *M* good produced in the ROW partially offsets increasing demands on the *M* good produced in FTA countries.
- At prohibitively high level of external tariffs, increasing total demand in country 1 only originates from a substantial increase in demands on *M* good produced in another FTA country. Increasing demands on *M* good produced in country 2 outweighs both decreasing demands on *M* good produced domestically and in the ROW.
- On the other hand, increasing total demand in country 2 only originates from a substantial increase in demands on the *M* good produced in country 1. This increase in demands on the *M* good outweighs both decreasing demands on the *M* good produced domestically and in the ROW.
- It can clearly be seen from figure 5.18 to 5.20 that the formation of a FTA between symmetric countries results in trade creation, since

member countries replace their demands from inefficient suppliers by more efficient producers in other member countries after a FTA formation.

For country 1, an instantaneous eradication of intra-FTA tariffs is no longer a dominant policy − in term of both indicators (i) and (ii) – as it does not attract the highest number of firms to the FTA countries nor yields the highest welfare gain to FTA's countries. However, an eradication of intra-FTA is still a dominant policy for country 2. Both total and partial intra-FTA tariff reduction policies yield similar results: as the external tariff rate increases, these policies attract investments into FTA countries until most of the firms agglomerate in the FTA countries. At the intermediate external tariff rates, firms almost fully agglomerate in the FTA countries. The allocation of firms will converge to the dispersed equilibrium allocation as the external tariff increases to prohibitively high levels. However, a partial intra-FTA tariffs reduction potentially lead to an internal catastrophic agglomeration (or a two-tier home-market effect) – in which all firms agglomerate in country 1 where it has lower external tariffs. The formation of a FTA between symmetric countries also generates trade creation. Finally, an instantaneously eradication of intra-FTA tariff policy is a Pareto improving, if the external tariffs are sufficiently high. Otherwise, such FTA formation policy results in increasing welfare in FTA countries at the expense of the ROW.

In the formation of a CU between symmetric countries, we find that member countries will have a higher benefit from welfare gain, if they choose to eradicate rather than partially reduce their intra-tariffs. This result is in contrast to that of Lipsey (1960) and Bhagwati (1999 p.6) who find that the eradication of intra-tariffs is less likely to increase welfare than a partial intra-tariffs reduction. However, their

suggestion may be true in the case of a FTA formation where an internal catastrophic agglomeration or a two-tier home-market effect occur. A partial intra-FTA tariffs reduction will yield country 1 a higher level of welfare gain − at the expense of country 2 – than an intra-FTA tariffs eradication.

Finally, it is worth noting that the CU formation between symmetric countries − when member countries differ in their initial level of external tariffs and change them to the common external tariffs after the CU formation − generates a relatively similar result to that of a FTA formation between symmetric countries.

5.5.2 The effects of the formation of a PTA when countries are asymmetric

We have known from the previous section that an eradication of intra-tariff to form a CU or a FTA yields relatively similar outcomes. This policy creates a considerable large common market within the PTAs bloc. An eradication of intra-tariff between PTAs member countries unambiguously diverts investments away from the ROW. In this section we turn to examine the effects of PTA formation between asymmetric countries. In doing so, we allow countries' characteristics to be different. Specifically, we consider two particular cases – namely they differ in: **(i)** the total expenditure on the *M* good, and **(ii)** the cost of production. Without loss of generality, we make use of simulations to examine the effects of PTA formation between asymmetric countries. We assume that country 1 and 2 choose to form a FTA. In particular, we use the same setup as in the preceding section, in which we assumed that − prior to the PTA formation – governments impose import tariffs such that $\tau_{s,r} = \tau_{s,1} + 0.1,\ r \in \{2,3\}$, $s \in \{1,2,3\}$, and $r \neq s$. We carry out simulations of the intra-FTA tariff reduction at different levels of external tariff rates (ranging from low to prohibitively high). In the first case, we assume that there are two groups of

countries – i.e. a small and a large country. In the second case, we assume that there are two groups of countries, characterised respectively by a low and a high marginal product of the composite input.

5.5.2.1 The effects of the formation of a PTA when countries are different in total expenditure of M good.

Prior to a formation of PTA, firms would earn higher profit from choosing to produce in high tariffs countries and export to low tariffs countries − if the levels of external tariffs between countries are different − as long as the level of external tariffs are not too high. This incentivises firms to concentrate in high tariffs countries, especially when the external tariff rates are at intermediate level, as shown in figure 5.21. A concentration of firms in high tariffs countries occurs, even if the sizes of low tariffs country are slightly larger than the low tariffs country regardless of the level of vertical linkages.[26] After the formation of a PTA, the effects of an instantaneous eradication of intra-PTA tariffs on the allocation of firms in member countries and in the ROW are similar to those of the formation of a CU and a FTA discussed in the previous section. Specifically, most of the firms will agglomerate in member countries, as shown by an allocation of firms after a PTA formation in figure 5.22. This similar pattern of agglomeration occurs regardless of whether the countries choose a CU or a FTA − or whether the formation of a preferential trade agreement is between small countries or between large and small country. The main difference in outcome between the two types of PTA formation – i.e. CU and FTA – is that under a CU formation firms are equally spread between member countries,

[26] In this simulation, we assume that a larger country has the number of population and amount of capital endowment equal to 110. While a smaller country has the number of population and amount of capital endowment equal to 100. The level of vertical linkages is set such that $\gamma = 0.60$.

while the share of firms in low tariff member country is slightly higher than that of high tariff member country under a FTA formation.

The effect of a FTA formation on the change of welfare in country 1, country 2 and the ROW are also comparable to those of CU countries and the ROW from the analysis of a CU formation in the previous section, as shown by a change in welfare after a FTA formation in figure 5.23:

- Generally, a reduction of intra-FTA tariffs causes welfare in both FTA countries to increases as the intra-FTA tariff rates fall. The higher the external tariff rate, the larger the welfare increases. However, welfare increases until it reaches its peak at the high level of external tariff rates.
- When the external tariffs are sufficiently high, an intra-FTA tariff eradication policy also benefit the ROW. Otherwise, FTA countries gain in welfare at the expense of the ROW.

The formation of a FTA − when the sizes of country are slightly different − results in trade creation, since member countries replace their demands from inefficient suppliers by efficient producers in other member countries after a FTA formation. The effect of FTA formation on the change of demand and prices of individual varieties in country 1, country 2 and the ROW are also comparable to those of FTA countries and the ROW from the analysis of FTA formation in the previous section, as shown by figure 5.24 – 5.26:

However, the effects of PTA formation are different from the previous case, when the formation is between small countries, whereas the sizeable country is left in the ROW. Specifically, in this scenario, after the formation of the PTA, the combined

size of member countries is slightly larger than the size of the ROW.[27] Prior to the formation of a PTA, a larger total expenditure on the *M* good − which originates from the larger size of the country − creates backward linkages effect that attract firms to the country. In particular, most of the firms will agglomerate in the larger country, when the external tariff rates are at intermediate level, as shown in figure 5.27. After the formation of a PTA between small countries, the effects of intra-PTA tariffs eradication on the allocation of firms in member countries and the ROW are comparable to those of the formation of a CU and a FTA in the previous section. Specifically, most of the firms will agglomerate in member countries, when the tariff rates are at intermediate level − as shown by an allocation of firms after the formation of a FTA in figure 5.28.

On the other hand, the effects of PTA formation on the change of welfare are different from the previous section, as shown in figure 5.29:

- An eradication of intra-PTA tariffs causes welfare in both PTA countries to increase, except when the tariff rates are high.
- PTA countries gain in welfare at the expense of the ROW. Thus the ROW suffers from a welfare loss as a consequence of PTA formation between small countries regardless of the level of external tariffs.

The decomposition of the effects of a PTA formation on welfare change in country 1 and country 2, which are shown in figure 5.30 and 5.31, respectively, displays comparable outcomes to those of the formation of a PTA between symmetric countries in the previous section. However, the decomposition of the effects of a PTA formation on welfare change in the ROW is different, as shown in figure 5.32:

[27] In this simulation, we assume that a larger country has a population size and a capital endowment equal to 180, while each smaller country has population size and capital endowment of 100.

- The ROW's consumers suffer from a welfare loss because a considerable negative TR effect outweighs a positive CS effect.
- A loss of welfare caused by a negative CS effect in the ROW reaches the lowest point, when the tariff rates are at intermediate level. This point corresponds to a change of allocation of firms from which firms agglomerate in country 3 to spread equally across all countries after the formation. Then the level of welfare moves toward its initial level as the tariff rates increase to high and prohibitively high level.

The formation of a PTA in this case results in trade diversion, since member countries replace their demands from more efficient suppliers by inefficient producers in other member countries after the PTA formation, as shown in figure 5.33 to 5.35:

- Total demand in PTA countries rises as a result of a change in the CES price indices and prices of individual varieties.
- Increasing total demand in each PTA country comprises of an increase in demands on the *M* good produced in another PTA country as well as an increase in demands on domestically produced *M* good. The levels of increasing demands on *M* good produced in another PTA country and on domestically produced *M* good are relatively similar. However, decreasing demands on *M* good produced in the ROW partially offsets increasing demands on *M* good produced in FTA countries.
- Prices of individual varieties produced in both PTA countries decrease, after a PTA formation, while prices of individual varieties produced in the ROW increases.

- However, prices of individual varieties produced in both PTA countries after the formation are higher than prices of individual variety produced in country 3 prior to the formation, except when the external tariff rate are very low.

The effect of PTA formation − when the sizes of countries are slightly different − are comparable to those obtained under country symmetry. The formation of a PTA will attract investment into PTA countries. Therefore, most of the firms will agglomerate in member countries after the formation. Generally, a reduction of intra-PTA tariffs causes welfare in both PTA countries to increases as the intra-PTA tariff rates fall. When the external tariffs are sufficiently high, an intra-PTA tariff eradication policy also benefit the ROW. This formation also results in trade creation.

However, the effects of PTA formation are different when the formation is between small countries and the sizeable country is left in the ROW. The formation of a PTA will attract investment into PTA countries. Therefore, most of the firms will agglomerate in member countries after the formation, particularly when the external tariffs are at intermediate level. However, the ROW will suffer from a welfare loss as a consequence of the formation. While both countries' welfare increase, except when the external tariff rates are high. Furthermore, the formation of a PTA in this case results in trade diversion.

5.5.2.2 The effects of the formation of a PTA when countries are different in the cost of production of M good.

Profit maximizing firms will have an incentive to relocate to the country where they can minimize their cost of production. Firms can either choose to minimize the cost of intermediate inputs or increase their productivity. In this section, we look at the

case where firms in different countries have different levels of productivity. We focus on the effect of changes in an exogenous variable that has a direct effect on the productivity of the firms − which is the marginal product of the composite input. We will examine the effect of differences in the marginal product of the composite input among countries after the formation of a PTA. In doing so, we relax the assumption that firms in different countries are homogeneous and, therefore, assume that the marginal product of a composite input, $1/\beta_r$, of firms in different countries are different. However, we continue to assume that firms located in the same country are homogeneous, which means having an identical marginal product of a composite input. These set of assumptions imply that factor productivity is not specific to individual firm, but is instead location specific – i.e. it belongs to country characteristics. This can be due to several reasons − for example labour in different countries may have different levels of skill and firms that operate in a country with a more skilled labour force may thus be able to use more advances and sophisticated machines in the production process. This may raise firms' factor productivity above that of firms located in a country characterized by a less skilled labour force (thus unable to use the more advanced technology).

Prior to the formation of a PTA, a lower cost of production − which results from a higher marginal product of the composite input – creates a forward linkages effect that attract firms to operate in that country. In particular, most of the firms will agglomerate in a high factor productivity country when the external tariff rates are at intermediate level – as shown in figure 5.36.

After the formation of a PTA between high and low productivity countries, most of the firms will agglomerate in a higher productivity member country. There will be a small number of firms operating in a lower productivity member country.

Furthermore, this agglomeration may imply the near disappearance of the industry in the ROW, particularly if the external tariff rates are at intermediate level, as shown by the allocation of firms after the formation of a PTA in figure 5.37. A similar result is also to be found in Kim (2007), where a PTA formation between countries that are different in factor costs increases intra-bloc vertical FDI. The effects of a PTA formation between high and low productivity countries on the allocation of firms in member countries are different from those of the formation of a PTA when countries differ in total expenditure on *M* good. Specifically, a difference in factor productivity causes a disparity between the costs of production and, eventually, countries' rate of return even if intra-tariff is no longer in existence. This is different from the case when countries are different in total expenditure – when a free intra-trade between member countries equalizes countries' rates of return.

After the formation of a PTA, a high productivity country and the ROW suffer from a slight welfare loss only if the external tariffs are low. Otherwise, the formation of a PTA results in welfare gain from both PTA member countries and the ROW, as shown in figure 5.38. The higher the external tariff rate, the larger the welfare increases.

The decomposition of the effect of a PTA formation on welfare changes in country 1, country 2 and the ROW are different from previous cases as shown in figure 5.39 to 5.41, respectively:

- A change in capital income has only a slight effect on total welfare. Moreover, every country displays a similar pattern of change in welfare caused by this effect. The higher the external tariff rate, the larger the welfare increases from capital income effect.

- Country 1, which is a high productivity PTA member country, and the ROW suffer from a negative CS effect. A negative CS effect results from the existence of firms operating in Country 2, which is a low productivity PTA member country. This causes price indices in country 1 and the ROW increase relative to prior to the formation of the PTA. However, this negative effect is offset by both capital income and TR effects.
- Country 2 is the only one that benefit from a CS effect after the formation of the PTA. However, its welfare gain is partially offset by a negative TR effect.

The formation of the PTA in this case results in trade creation, since increasing demand from more efficient suppliers overtakes increasing demand from inefficient producers after a PTA formation, as shown in figure 5.42 to 5.45:

- Prices of individual varieties in country 1 and the ROW slightly increase, while those prices in country 2 decrease after the formation of the PTA.
- Total demand in country 1 falls, if the external tariffs are at low and intermediate levels. Then, total demand in country 1 rises when the external tariffs are at high and prohibitively high level.
- Total demand in country 2 rise as a result of a reduction in the CES price indices.
- Increasing demand from producers in country 1 overtakes the increasing demand from producers in country 2, while demand from producers in the ROW is relatively unchanged, after a PTA formation.

However, the effects of a PTA formation − when it is between lower productivity countries and the ROW is a higher productivity country − are different from the ones previously analysed. Prior to the formation of a PTA, most of the firms will agglomerate in a high factor productivity country if the external tariff rates are at intermediate level. The allocation of firms is similar to that is shown in figure 5.36.

The formation of a PTA creates a forward linkages effect that attracts some firms to relocate to PTA member countries, when the external tariffs are at high and prohibitively high level, as shown by the allocation of firms after the PTA formation in figure 5.46. Specifically, in our simulation, there is a dispersion of firms, when the external tariffs are at prohibitively high level.

The effects of PTA formation on the change of welfare are different from the previous section, as shown in figure 5.47:

- A formation of PTA results in a slight welfare loss in every country, when the external tariffs are at low and intermediate level. A substantial loss of welfare occurs, when the external tariffs are at high and prohibitively high levels – when a substantial amount of firms relocate to PTA countries. The higher the external tariff rate, the larger the welfare decreases.

The decomposition of the effect of PTA formation on welfare change in country 1 and the ROW are shown in figure 5.48 to 5.49, respectively:

- A change in capital income has only a slight effect on total welfare. Moreover, every country displays a similar pattern of change in welfare caused by this effect.
- A decrease in welfare in country 1 mainly results from a negative CS effect, when external tariffs are at low, intermediate and high level. A

negative CS effect is a result of an increase in consumer price indices in both PTA countries. On the other hand, a substantial drop of welfare is mainly due to a negative TR effect, when the external tariffs are at prohibitively high level.

- A decrease in welfare in country 2 is analogous to that of in country 1.
- A decrease in welfare in the ROW is mainly due to a negative CS effect, particularly when the external tariffs are at high and prohibitively high level.

The formation of a PTA in this case results in trade creation, when the external tariffs are at low, intermediate and high level. At this level, increasing demands in member countries is mainly acquired from more efficient suppliers in the ROW. However, this type of formation results in trade diversion, when the external tariffs are at prohibitively high level. This is because member countries replace their demands from more efficient suppliers in the ROW by both inefficient domestic producers and producers in other member countries, as shown in figure 5.50 to 5.51.

The PTA formation between the high and low cost of production countries will attract most of firms to operate in a lower cost PTA member countries. There will be some small fraction of firms operating in a lower productivity member country, while firms almost totally disappear from the ROW. A high productivity country and the ROW suffer from a slight welfare loss only if the external tariffs are low. Otherwise the formation of a PTA results in welfare gain from both PTA member countries and the ROW. Furthermore, the formation of a PTA in this case results in trade creation.

However, a PTA formation between low productivity countries, while a high productivity country is the ROW, creates a dispersion of firms among PTA member

countries and the ROW, when the external tariffs are prohibitively high level. While, firms tend to agglomerate in a high productivity country at other levels of tariffs. This formation results in a slight welfare loss in every country, when the external tariffs are at low and intermediate level. A substantial loss of welfare occurs, when the external tariffs are at high and prohibitively high level. The formation of a PTA in this case results in trade creation, when the external tariffs are at low, intermediate and high level. However, this type of formation results in trade diversion, when the external tariffs are at prohibitively high level. Finally, it is worth noting that the PTA formation − when countries are different in the level of vertical linkages − generates a relatively similar result to that of a PTA formation − when countries are different in the marginal product of the composite input. This similar result causes by very strong agglomeration forces generated from a difference in levels of vertical linkages – which not only makes countries differences in their cost of production, but also generates a difference in total expenditures on *M* good.

5.6 Conclusion

The formation of a PTA can be a highly effective instrument for policymakers to use as a means to raise social welfare. The formation of a PTA creates a considerable large common market within the PTA bloc. This, in turn, generates backward linkages effects that attract firms to relocate into PTA member countries. We analyse the effect of the formation of a PTA on the movement of firms, the change in social welfare as well as the diversion or creation of trade. The desirability of this policy is based upon the criterion that it raises consumers' welfare by attracting investment in the country. This investment determines the number of firms that reallocate across countries. It is worth noting that the use of the terms

“CU” and “FTA” in this thesis ensures that the condition of the eradication of internal tariffs is consistent with the approach followed in the literature. Instead, the CU and FTA are assumed to apply the initial tariffs to imports from the rest of the world. Therefore, this makes the present exercise basically different from what is found in the literature that uses optimal tariffs approach and as such it is not possible to compare the result. The results of our analysis can be summarized as follows.

An eradication of intra-tariff between PTA member countries always attracts investments from the ROW. If all countries are symmetric, not only does the PTA formation make PTA member countries better off, but it can also generate a welfare gain in the ROW. However, the ROW may be made worse off at some levels of external tariff rates. Additionally, we find that this type of formation is generally a trade creating PTA.

We also find a similar result when the sizes of country are slightly different. On the other hand, the PTA formation – which is between small countries that leave the sizeable country out of the agreements − generates a welfare gain to the member countries, except when the external tariffs are high. In this case, the ROW would be made worse off at any level of external tariffs. Even though this type of PTA formation generates a welfare gain to the member countries, it is, however, a trade diverting PTA.

A country with the high cost of production will be able to retain a small fraction of firms to operate in the country when it forms a PTA with the low cost of production country while almost all of the firms disappear from the ROW. Not only does this type of PTA formation make the PTA member countries – specifically, the one with the high cost of production − better off, but it can also generate a welfare gain in the ROW. However, the member with the low cost of production and the

ROW may be made worse off at some levels of external tariff rates. Additionally, we find that this type of formation is generally a trade creating PTA.

Finally, a PTA formation between low productivity countries that leaves a high productivity country out of the agreements makes both member countries and the ROW worse off. Even though this type of formation generates trade creating PTA, when the external tariffs are at low, intermediate and high levels, it generates trade diverting PTA when the external tariffs are at prohibitive high levels. These finding support the proposition in Venables (1999) that developing countries may have higher benefit from 'North–South' agreements than from 'South-South' agreements.

In these instances, the losses from the PTA formation then create an incentive for policymakers in the ROW to attempt to retain their existing investment and avoid welfare loss. In order to do so, policymakers has several options. One of the options is to join the PTA agreement; this option, that would be congruent to the goal of multilateral trade liberalization, would make every country better off. Alternatively, policymakers in the ROW may consider using either its CIT or tariffs as tools to retain and/or attract internationally mobile firms; we will study the effect of these policies in the next chapter.

Appendix

5-A Tables

Table 5.1 The direction of change in dependent variables due to the change in explanatory variables.

eq.	Dep. var.	Explanatory variables																																
		$d\tau$	$d\varepsilon$	dL	dK	dn_1	dp_1	dp_3	$dP_{M,1}$	$dP_{M,3}$	$d\Omega_1$	$d\Omega_3$	$dm_{1,1}$	$dm_{1,2}$	$dm_{1,3}$	$dm_{3,3}$	$dm_{3,1}$	$dz_{1,1}$	$dz_{1,2}$	$dz_{1,3}$	$dz_{3,3}$	$dz_{3,1}$	dx_1^S	dx_3^S	dr_1	dr_3	dY_1	dY_3	$dK_{r,1}$	$dK_{r,3}$	dTR_1	dTR_3
5.1	dp_1										(+)																							
5.2	dp_3											(+)																						
5.3	$dP_{M,1}$	(+)	(−)			(−)	(+)	(+)																										
5.4	$dP_{M,3}$	(+)				(+)	(+)	(+)																										
5.5	$d\Omega_1$								(+)																									
5.6	$d\Omega_3$									(+)																								
5.7	$dm_{1,1}$						(−)		(+)																		(+)							
5.8	$dm_{2,1}$	(−)	(+)				(−)		(+)																		(+)							
5.9	$dm_{3,1}$	(−)						(−)	(+)																		(+)							
5.10	$dm_{3,3}$							(−)		(+)																		(+)							
5.11	$dm_{1,3}$	(−)					(−)			(+)																		(+)							
5.12	$dz_{1,1}$						(−)		(+)		(+)													(+)											
5.13	$dz_{2,1}$	(−)	(+)				(−)		(+)		(+)													(+)											
5.14	$dz_{3,1}$	(−)						(−)	(+)		(+)													(+)											
5.15	$dz_{3,3}$							(−)		(+)		(+)													(+)										
5.16	$dz_{1,3}$	(−)					(−)			(+)		(+)													(+)										
5.17	dx_1^S					(+/−)							(+)	(+)	(+)				(+)	(+)	(+)														
5.18	dx_3^S					(+/−)										(+)	(+)					(+)	(+)												
5.19	dr_1						(+)				(−)																								
5.20	dr_3							(+)				(−)																							
5.21	dY_1			(+)																						(+)	(+)			(+)	(+)	(+)		
5.22	dY_3			(+)																						(+)	(+)			(+)	(+)		(+)	
5.23	$dK_{r,1}$				(+)																					(+)	(−)							
5.24	$dK_{r,3}$				(+)																					(−)	(+)							
5.25	dTR_1	(+)	(−)			(+/−)	(+)	(+)						(+)			(+)		(+)			(+)												
5.26	dTR_3	(+)				(+)	(+)								(+)					(+)														

5-B Figures

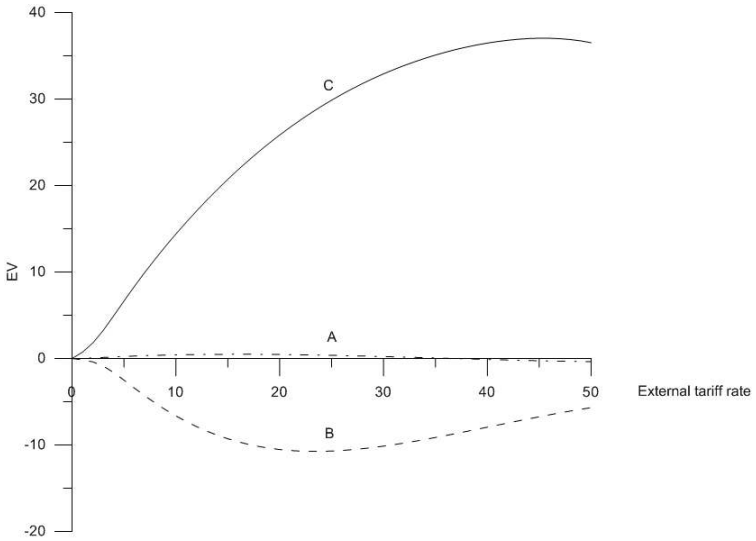

Figure 5.1 PTA and welfare change in CU countries

Capital income (A), government transfer (B) and consumer surplus (C) effects on welfare change after 100% intra-CU tariff reduction.

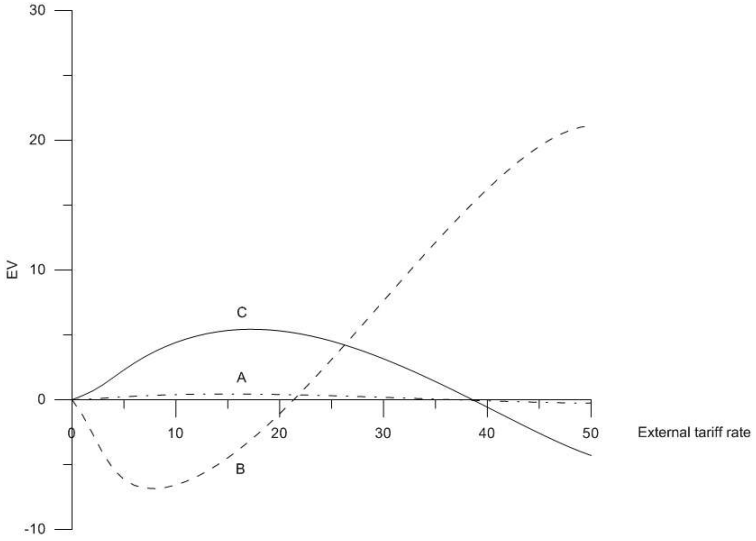

Figure 5.2 PTA and welfare change in the ROW

Capital income (A), government transfer (B) and consumer surplus (C) effects on welfare change after 100% intra-CU tariff reduction.

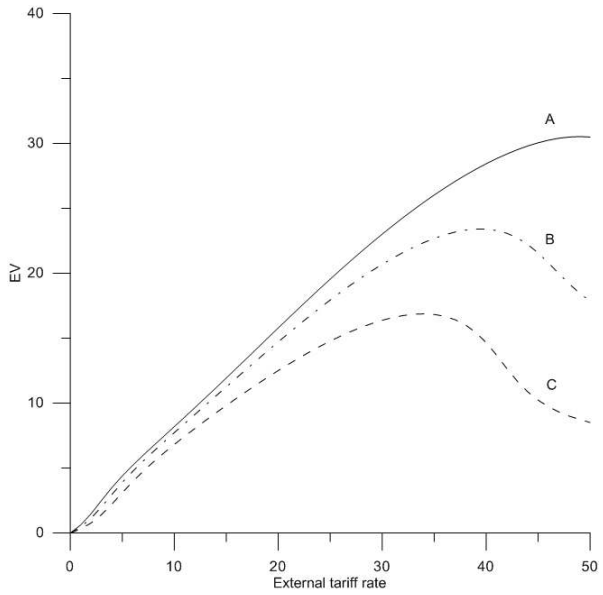

Figure 5.3 Intra-tariffs reduction and welfare change in CU countries

Welfare change in CU country from (A) 100%, (B) 75% and (C) 50% intra-CU tariff reduction.

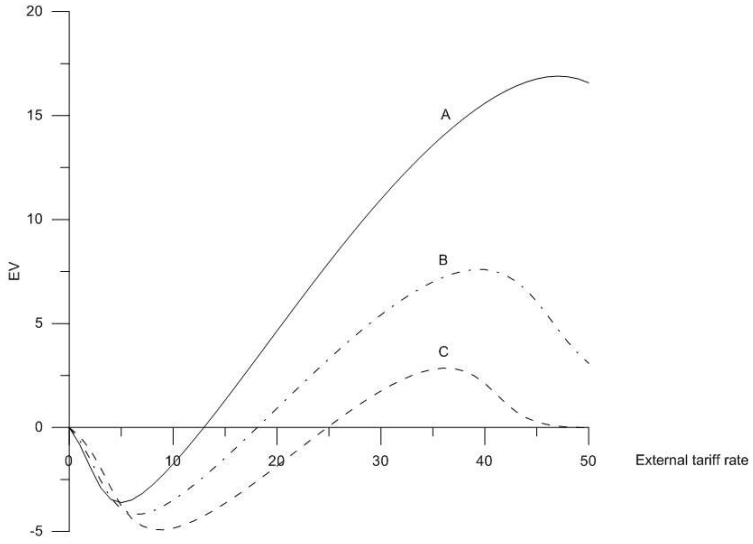

Figure 5.4 Intra-tariffs reduction and welfare change in the ROW

Welfare change in the ROW from (A) 100%, (B) 75% and (C) 50% intra-CU tariff reduction.

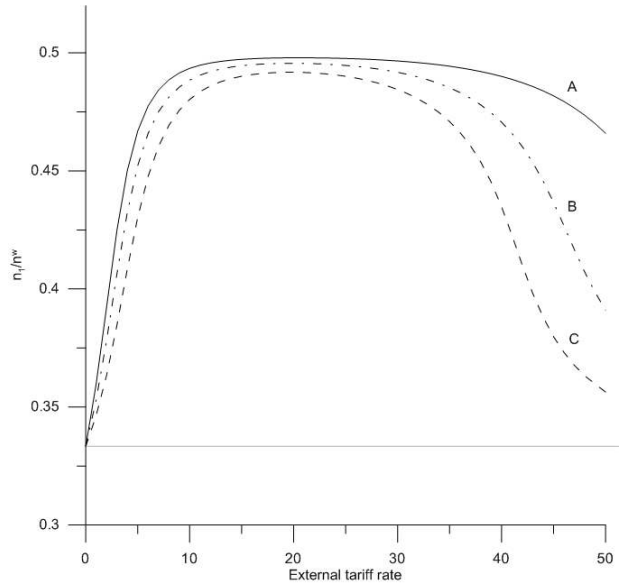

Figure 5.5 Intra-tariffs reduction and share of firms in CU country

Ratio of the number of firms in CU country to the total number of firms in the world from (A) 100%, (B) 75% and (C) 50% intra-CU tariff reduction.

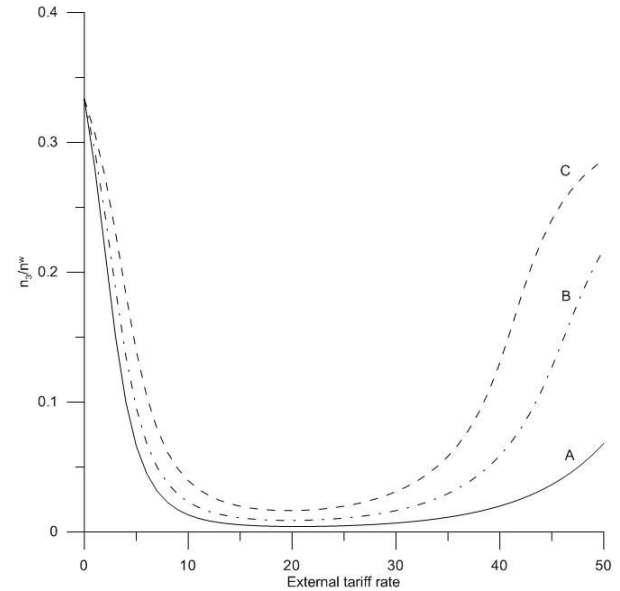

Figure 5.6 Intra-tariffs reduction and share of firms in the ROW

Ratio of the number of firms in the ROW to the total number of firms in the world from (A) 100%, (B) 75% and (C) 50% intra-CU tariff reduction.

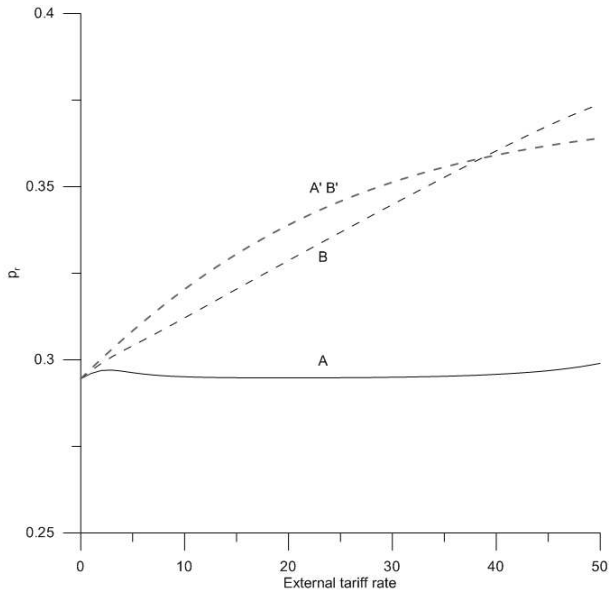

Figure 5.7 CU and prices of *M* good

Individual variety prices of *M* good after CU formation in (A) CU countries and in (B) the ROW, and individual variety prices of *M* good before FTA formation in (A′) Country 1, 2 and (B′) Country 3.

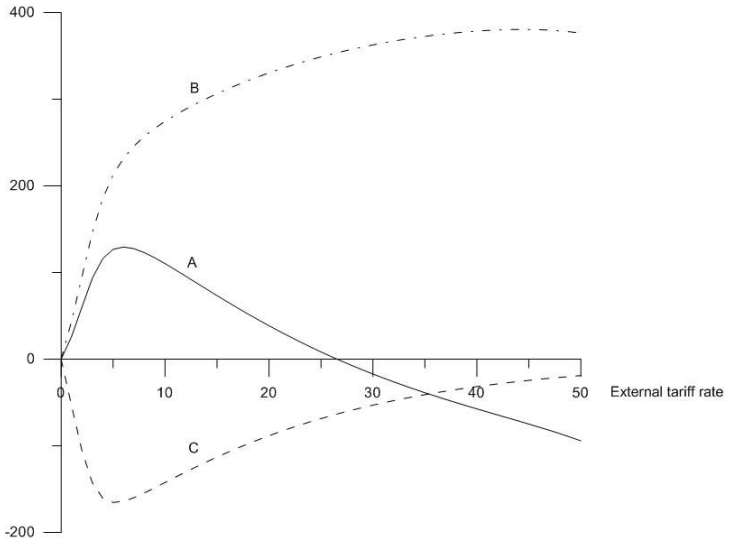

Figure 5.8 CU and changes in demand in Country 1

The changes in Country 1's demand on *M* good produced in (A) Country 1, (B) Country 2 and (C) the ROW after CU formation.

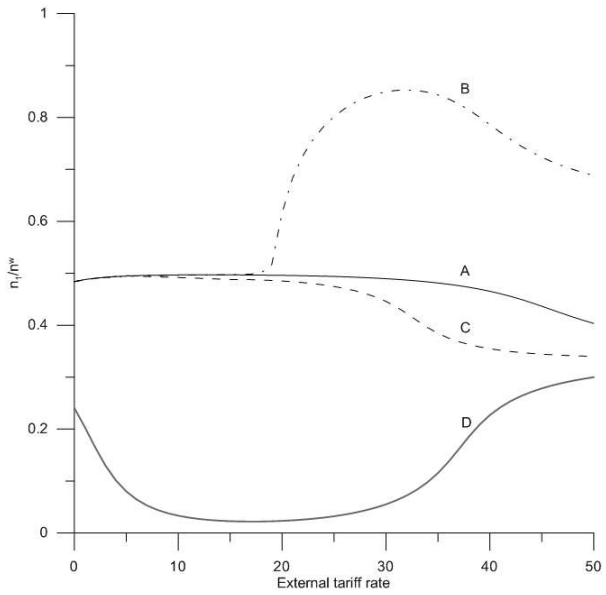

Figure 5.9 FTA and share of firms in Country 1

Ratio of the number of firms in Country 1 to the total number of firms in the world from (A) 100%, (B) 75% and (C) 50% intra-FTA tariff reduction.

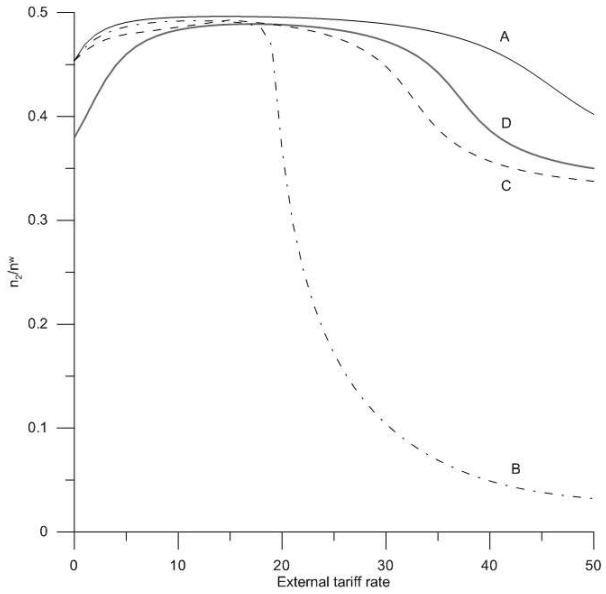

Figure 5.10 FTA and share of firms in Country 2

Ratio of the number of firms in Country 2 to the total number of firms in the world from (A) 100%, (B) 75% and (C) 50% intra-FTA tariff reduction.

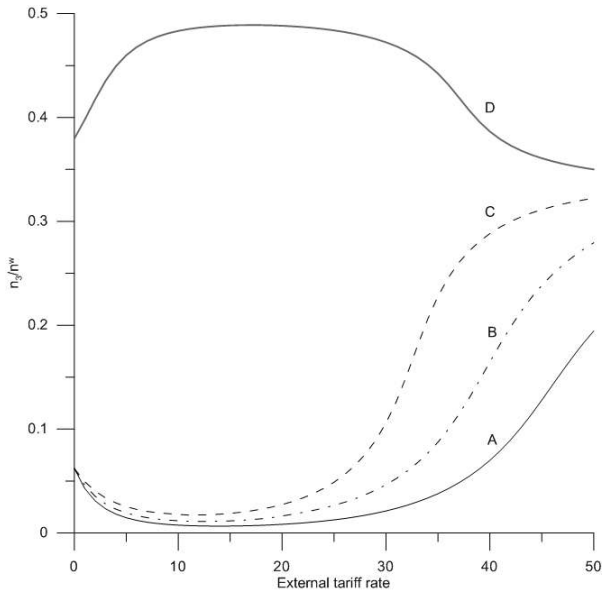

Figure 5.11 FTA and share of firms in the ROW

Ratio of the number of firms in the ROW to the total number of firms in the world from (A) 100%, (B) 75% and (C) 50% intra-FTA tariff reduction.

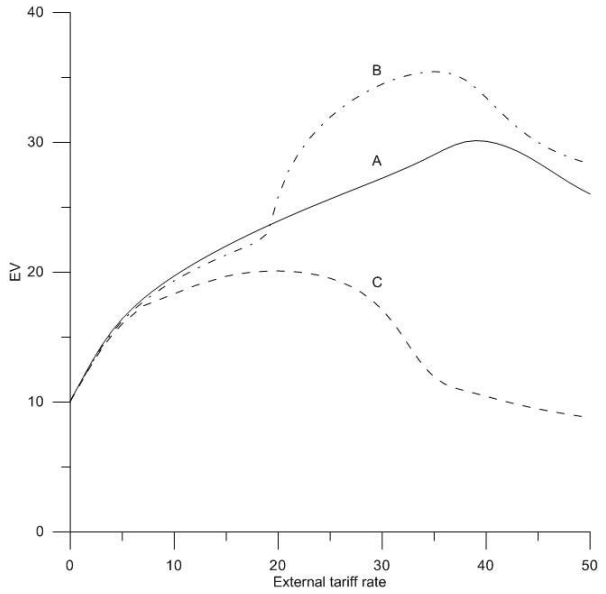

Figure 5.12 FTA and total welfare change in Country 1

Welfare change in Country 1 from (A) 100%, (B) 75% and (C) 50% intra-FTA tariff reduction.

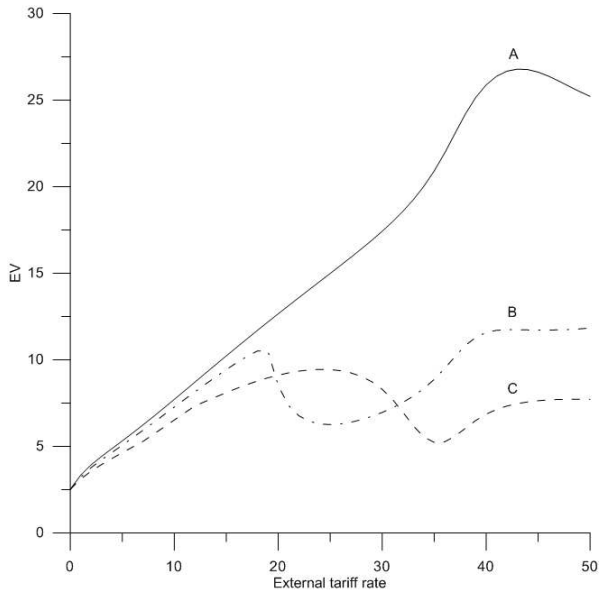

Figure 5.13 FTA and total welfare change in Country 2

Welfare change in Country 2 from (A) 100%, (B) 75% and (C) 50% intra-FTA tariff reduction.

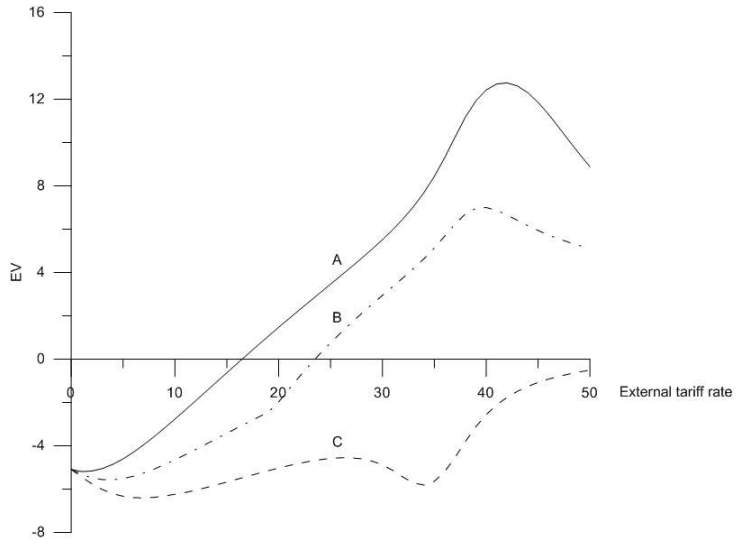

Figure 5.14 FTA and total welfare change in the ROW

Welfare change in the ROW from (A) 100%, (B) 75% and (C) 50% intra-FTA tariff reduction.

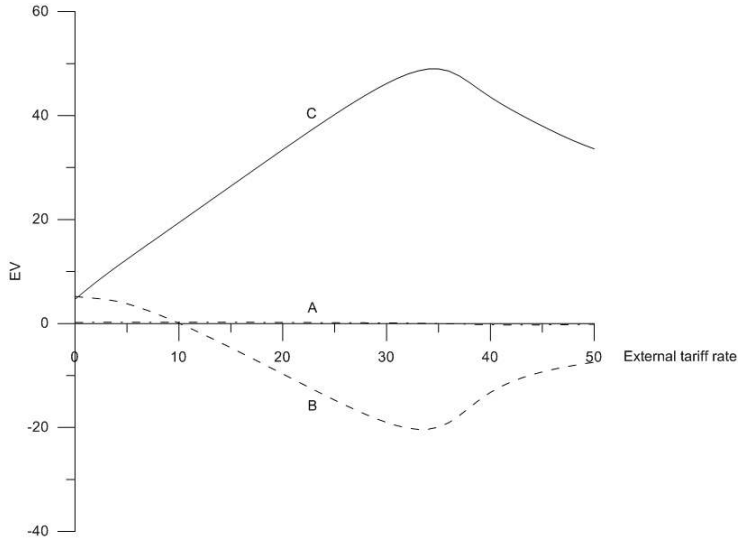

Figure 5.15 FTA and impact on welfare change in Country 1

Capital income (A), government transfer (B) and consumer surplus (C) effects on welfare change in Country 1 from 100% intra-FTA tariffs reduction.

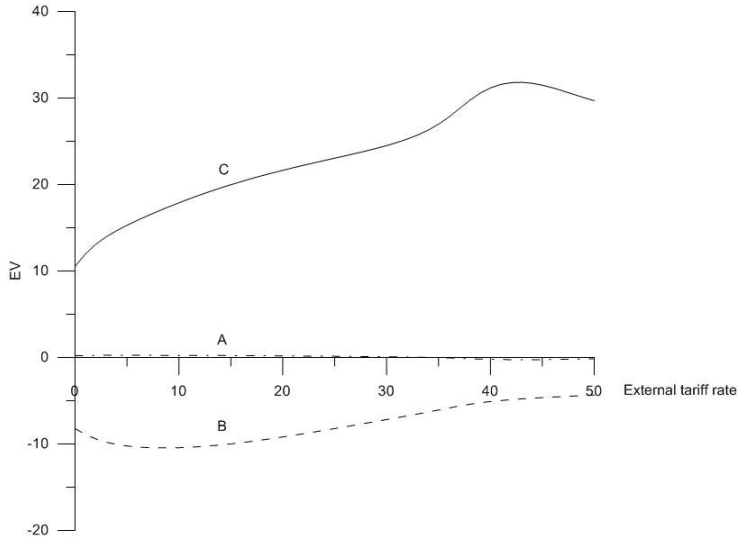

Figure 5.16 FTA and impact on welfare change in Country 2

Capital income (A), government transfer (B) and consumer surplus (C) effects on welfare change in Country 2 from 100% intra-FTA tariffs reduction.

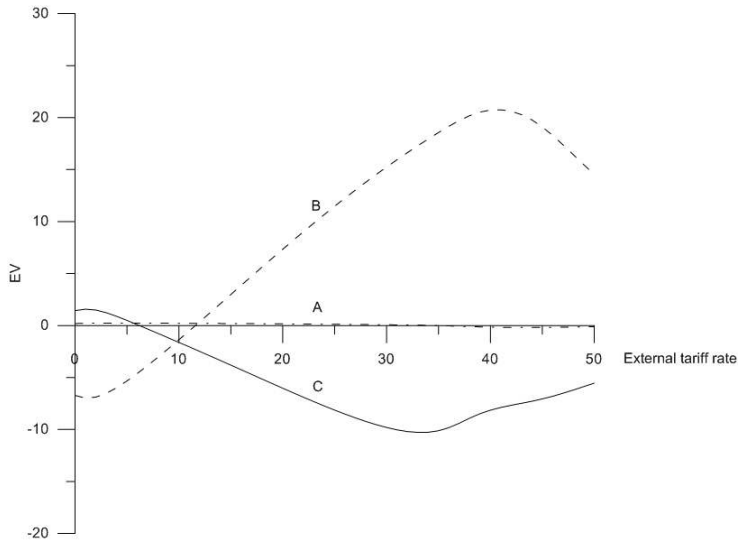

Figure 5.17 FTA and impact on welfare change in the ROW

Capital income (A), government transfer (B) and consumer surplus (C) effects on welfare change in the ROW from 100% intra-FTA tariffs reduction.

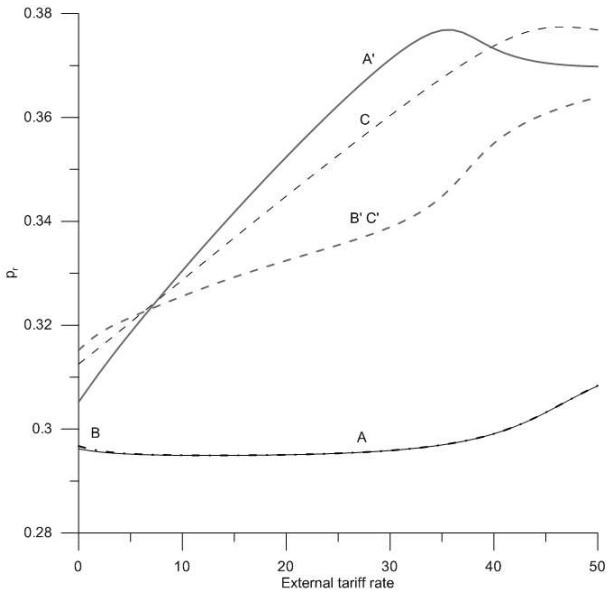

Figure 5.18 FTA and prices of *M* good

Individual variety prices of *M* good after FTA formation in (A) Country 1, (B) 2 and in (C) the ROW, and individual variety prices of *M* good before FTA formation in (A′) Country 1, (B′) Country 2 and (C′) Country 3.

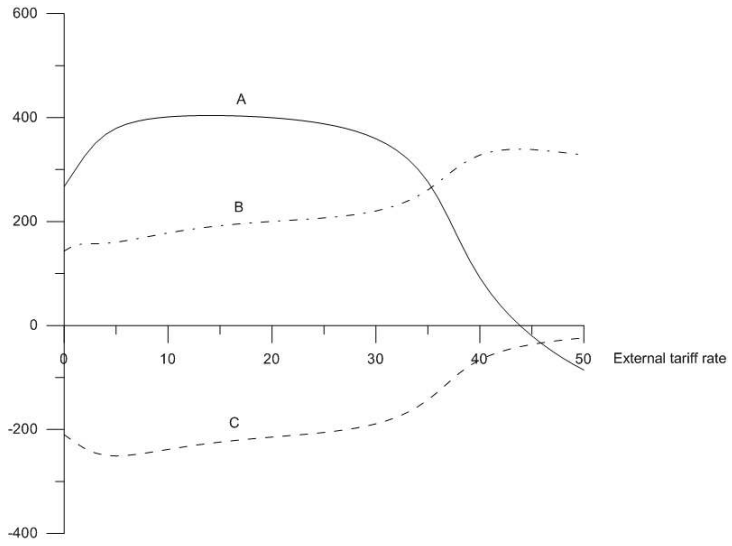

Figure 5.19 FTA and changes in demand in Country 1

The change in country 1's demands on *M* good produced in (A) Country 1, (B) Country 2 and (C) the ROW after FTA formation.

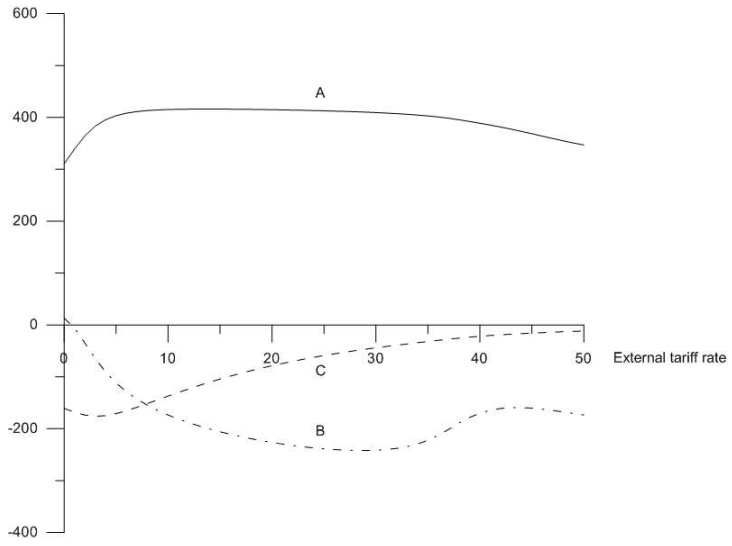

Figure 5.20 FTA and changes in demand in Country 2

The change in Country 2's demands on *M* good produced in (A) country 1, (B) country 2 and (C) the ROW after FTA formation.

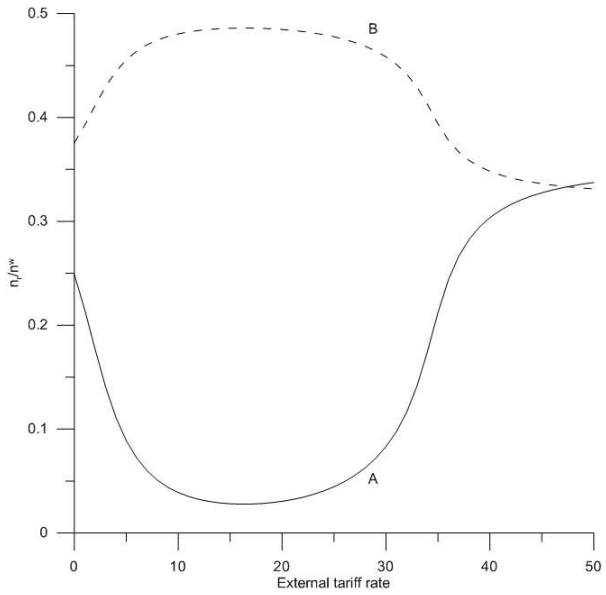

Figure 5.21 Share of firms prior to FTA formation ($L_1 > L_r$; $r \in 2,3$)

Ratio of the number of firms in (A) Country 1 and (B) Country 2 and 3 to the total number of firms in the world, where $L_1 = 110, K_1 = 110, L_r = 100, K_r = 100; r \in \{2,3\}$.

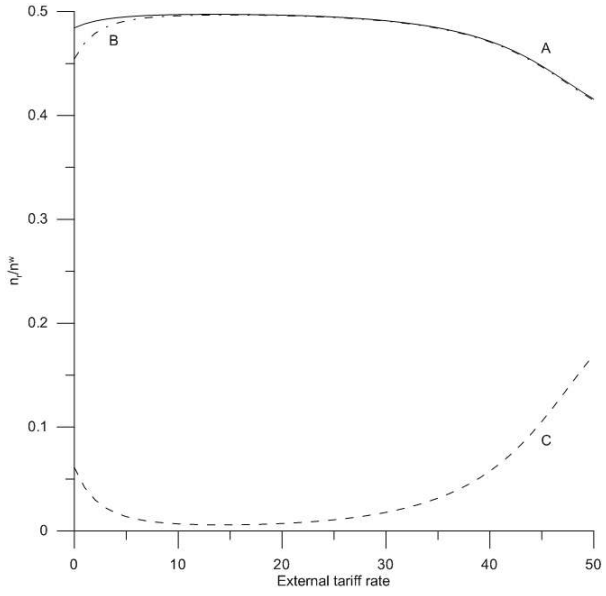

Figure 5.22 Share of firms after FTA formation ($L_1 > L_r$; $r \in 2,3$)

Ratio of the number of firms in (A) Country 1, (B) 2 and (C) the ROW to the total number of firms in the world, where $L_1 = 110, K_1 = 110, L_r = 100, K_r = 100; r \in \{2,3\}$.

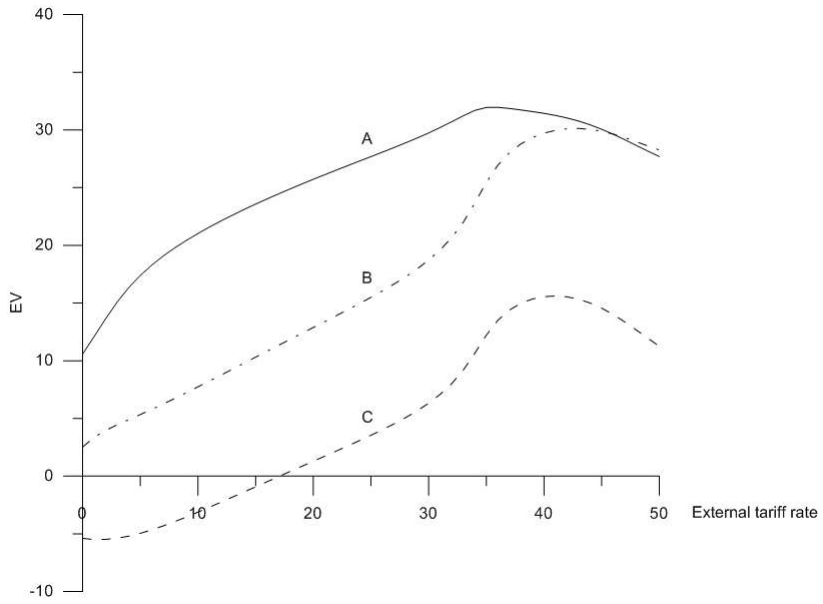

Figure 5.23 FTA and total welfare change ($L_1 > L_r$; $r \in 2,3$)

Welfare change in (A) Country 1, (B) Country 2 and (C) the ROW after the formation of FTA, where $L_1 = 110, K_1 = 110, L_r = 100, K_r = 100; r \in \{2,3\}$.

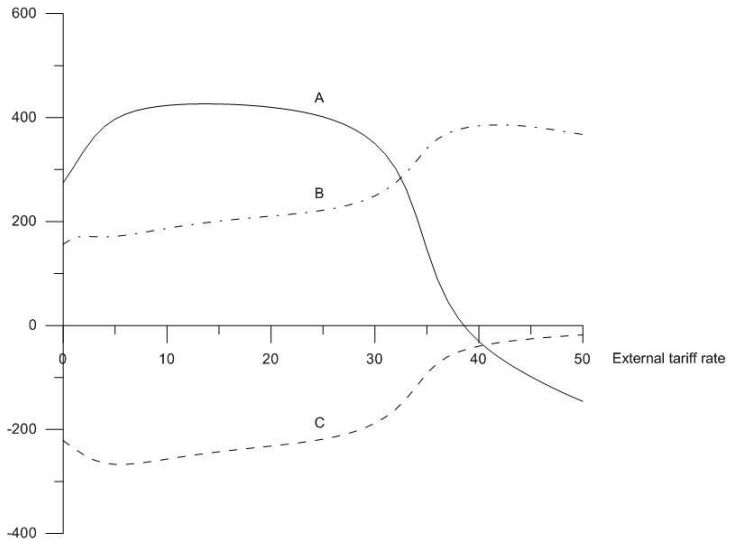

Figure 5.24 FTA and changes in demand in Country 1 ($L_1 > L_r$; $r \in 2,3$)

The change in Country 1's demands on *M* good produced in (A) Country 1, (B) Country 2 and (C) the ROW, where $L_1 = 110, K_1 = 110, L_r = 100, K_r = 100; r \in \{2,3\}$.

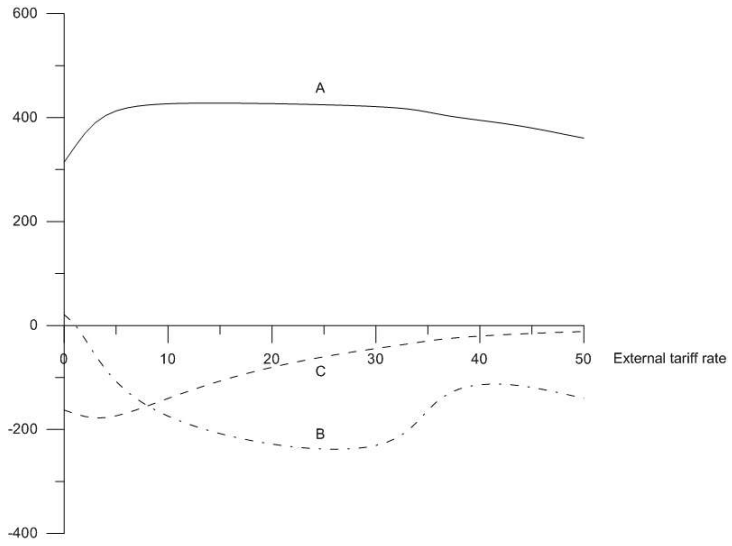

Figure 5.25 FTA and changes in demand in Country 2 ($L_1 > L_r$; $r \in 2,3$)

The change in Country 2's demands on *M* good produced in (A) Country 1, (B) Country 2 and (C) the ROW, where $L_1 = 110, K_1 = 110, L_r = 100, K_r = 100; r \in \{2,3\}$.

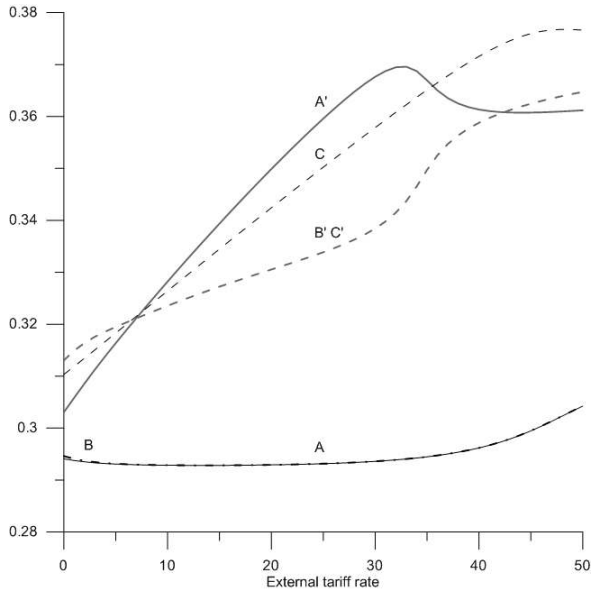

Figure 5.26 FTA and prices of *M* good ($L_1 > L_r$; $r \in 2,3$)

Individual variety prices of *M* good after FTA formation in (A) Country 1, (B) 2 and in (C) the ROW, and individual variety prices of *M* good before FTA formation in Country (A′) 1, (B′) 2 and (C′) 3, where $L_1 = 110, K_1 = 110$ and $L_r = 100$, $K_r = 100; r \in \{2,3\}$.

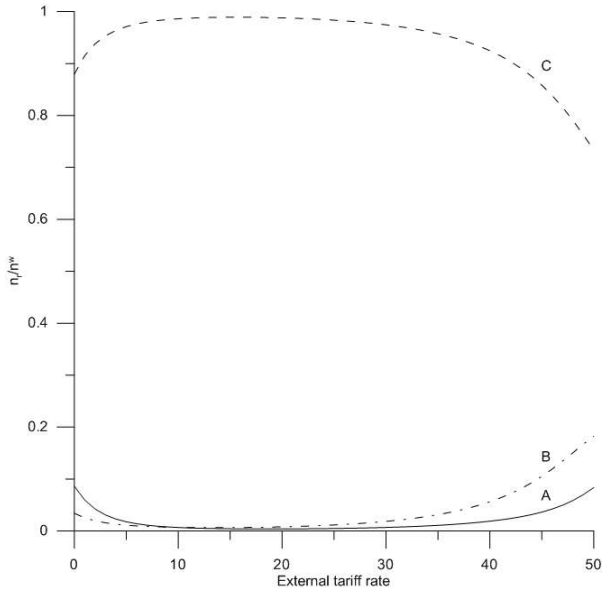

Figure 5.27 Share of firms prior to FTA formation ($L_r < L_3;\ r \in 1,2$)

Ratio of the number of firms in (A) Country 1, (B) Country 2 and (C) Country 3 to the total number of firms in the world prior to the formation of FTA, where $L_r = 100, K_r = 100;\ r \in \{1,2\}$ and $L_3 = 180, K_3 = 180$.

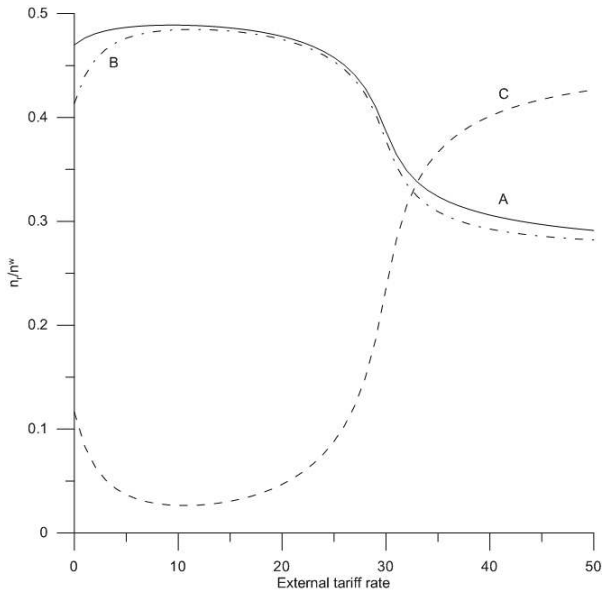

Figure 5.28 Share of firms after FTA formation ($L_r < L_3;\ r \in 1,2$)

Ratio of the number of firms in (A) Country 1, (B) Country 2 and (C) the ROW to the total number of firms in the world after the formation of FTA, where $L_r = 100, K_r = 100;\ r \in \{1,2\}$ and $L_3 = 180,\ K_3 = 180$.

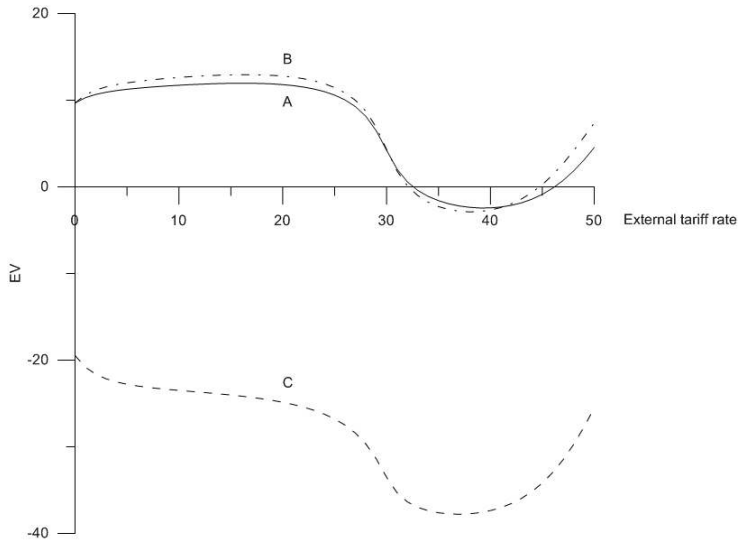

Figure 5.29 FTA and total welfare change ($L_r < L_3;\ r \in 1,2$)

Welfare change in (A) Country 1, (B) Country 2 and (C) the ROW after the formation of FTA, where $L_r = 100, K_r = 100;\ r \in \{1,2\}$ and $L_3 = 180,\ K_3 = 180$.

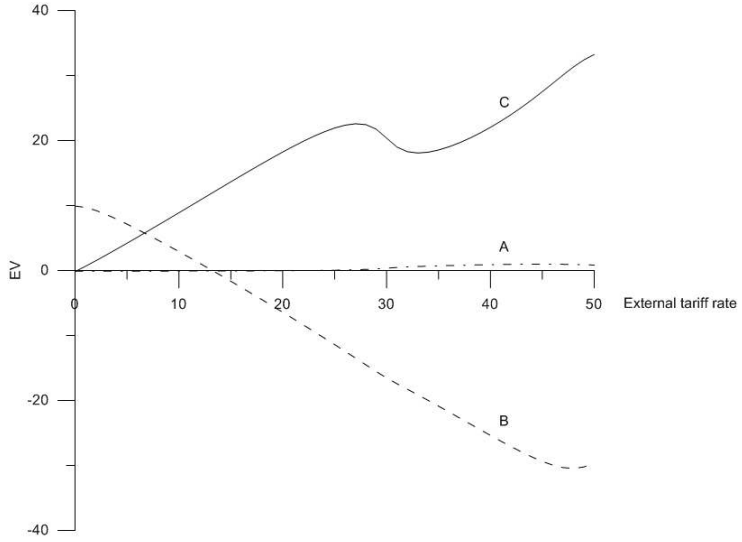

Figure 5.30 FTA and impact on welfare change in Country 1 ($L_r < L_3;\ r \in 1,2$)

Capital income (A), government transfer (B) and consumer surplus (C) effects on welfare change in Country 1 from intra-FTA tariffs eradication, where $L_r = 100,$ $K_r = 100;\ r \in \{1,2\}$ and $L_3 = 180,\ K_3 = 180$.

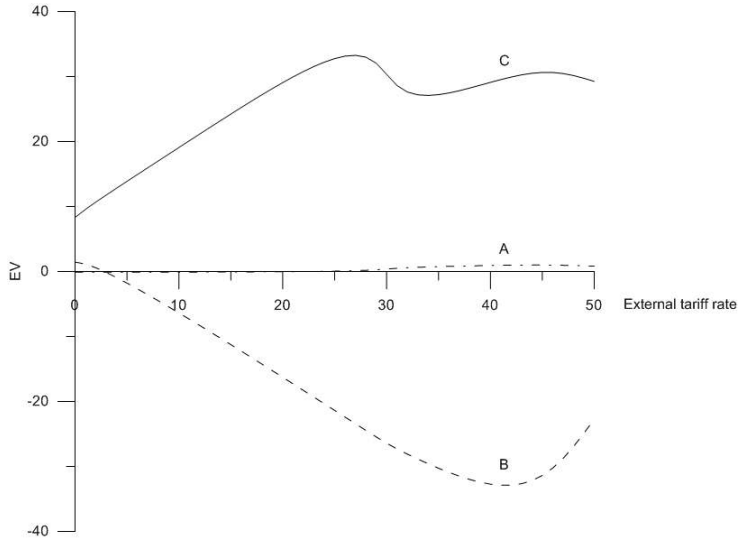

Figure 5.31 FTA and impact on welfare change in Country 2 ($L_r < L_3;\ r \in 1,2$)

Capital income (A), government transfer (B) and consumer surplus (C) effects on welfare change in Country 2 from intra-FTA tariffs eradication, where $L_r = 100$, $K_r = 100;\ r \in \{1,2\}$ and $L_3 = 180$, $K_3 = 180$.

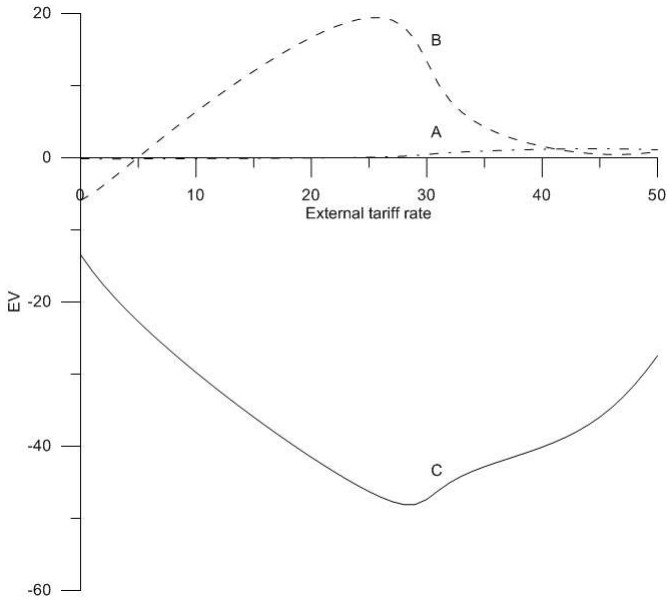

Figure 5.32 FTA and impact on welfare change in the ROW ($L_r < L_3;\ r \in 1,2$)

Capital income (A), government transfer (B) and consumer surplus (C) effects on welfare change in the ROW from intra-FTA tariffs eradication, where $L_r = 100$, $K_r = 100;\ r \in \{1,2\}$ and $L_3 = 180$, $K_3 = 180$.

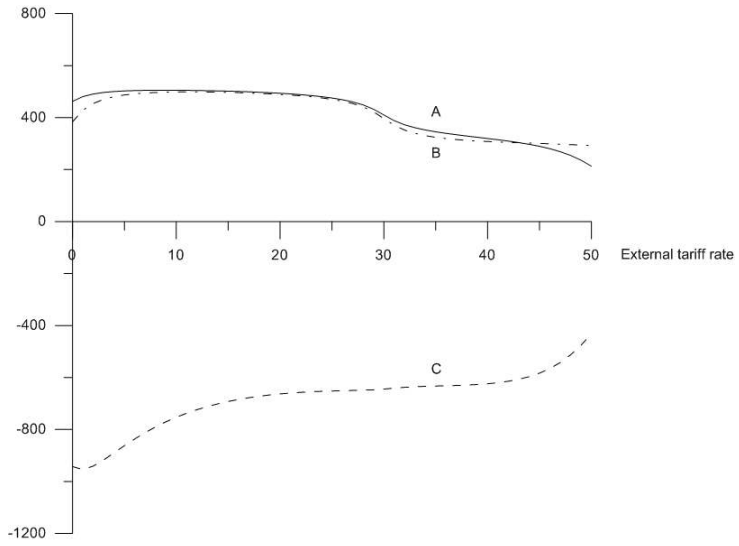

Figure 5.33 FTA and changes in demand in Country 1 ($L_r < L_3;\ r \in 1,2$ **)**

The change in country 1's demands on *M* good produced in (A) Country 1, (B) Country 2 and (C) the ROW after FTA formation, where $L_r = 100,\ K_r = 100;$ $r \in \{1,2\}$ and $L_3 = 180,\ K_3 = 180$.

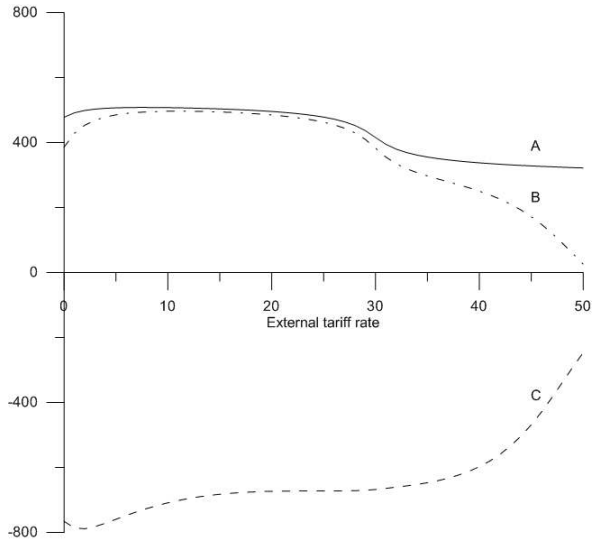

Figure 5.34 FTA and changes in demand in Country 2 ($L_r < L_3;\ r \in 1,2$ **)**

The change in Country 2's demands on *M* good produced in (A) country 1, (B) country 2 and (C) the ROW after FTA formation, where $L_r = 100, K_r = 100;\ r \in \{1,2\}$ and $L_3 = 180,\ K_3 = 180$.

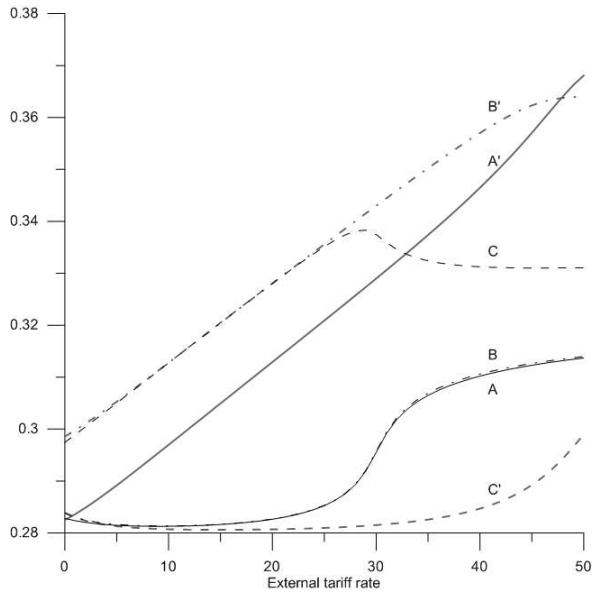

Figure 5.35 FTA and prices of *M*good ($L_r < L_3;\ r \in 1,2$)

Individual variety prices of *M* good after FTA formation in (A) Country 1, (B) 2 and in (C) the ROW, and individual variety prices of *M* good prior to FTA formation in Country (A′) 1, (B′) 2 and (C′) 3, where $L_r = 100, K_r = 100;\ r \in \{1,2\}$ and $L_3 = 180$, $K_3 = 180$.

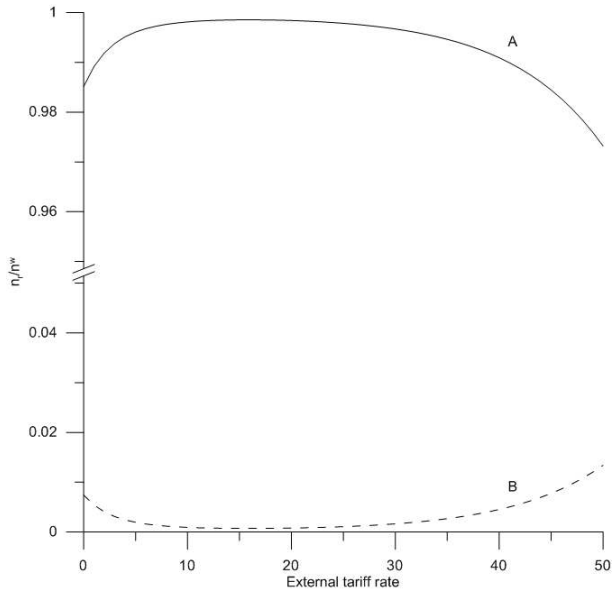

Figure 5.36 Share of firms prior to FTA formation ($\beta_1 < \beta_r;\ r \in 2,3$)

Ratio of the number of firms in (A) Country 1, (B) Country 2 and (C) Country 3 to the total number of firms in the world prior to the formation of FTA, where $\beta_1 = 0.9\beta_r$ and $\beta_r = \dfrac{\sigma - 1}{\sigma};\ \sigma = 8,\ r \in \{2,3\}$.

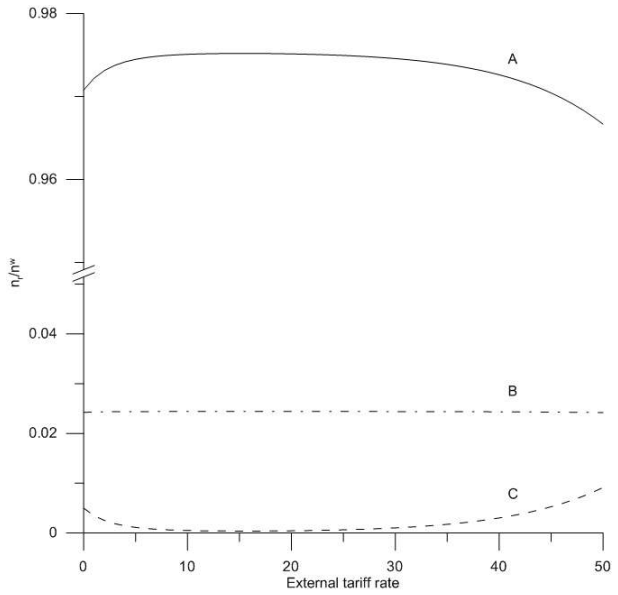

Figure 5.37 Share of firms after FTA formation ($\beta_1 < \beta_r$; $r \in 2,3$)

Ratio of the number of firms in (A) Country 1, (B) Country 2 and (C) the ROW to the total number of firms in the world after the formation of FTA, where $\beta_1 = 0.9\beta_r$ and $\beta_r = \frac{\sigma - 1}{\sigma}$; $\sigma = 8$, $r \in \{2,3\}$.

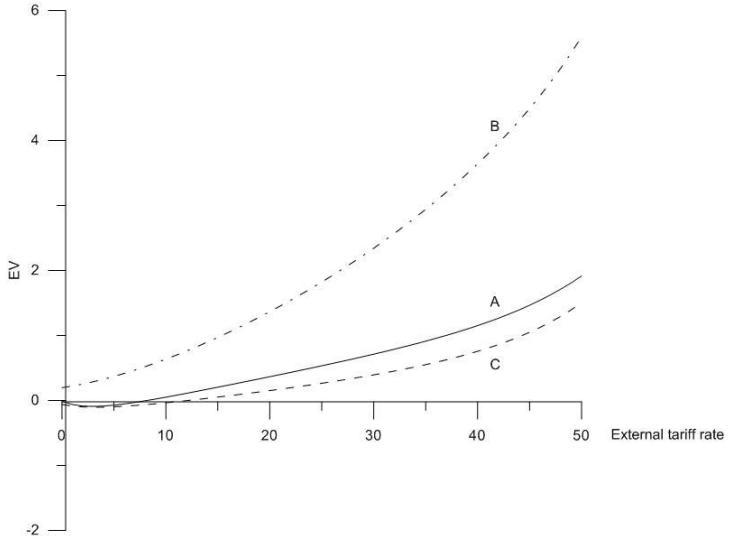

Figure 5.38 FTA and total welfare change ($\beta_1 < \beta_r$; $r \in 2,3$)

Welfare change in (A) Country 1, (B) Country 2 and (C) the ROW after the formation of FTA, where $\beta_1 = 0.9\beta_r$ and $\beta_r = \frac{\sigma - 1}{\sigma}$; $\sigma = 8$, $r \in \{2,3\}$.

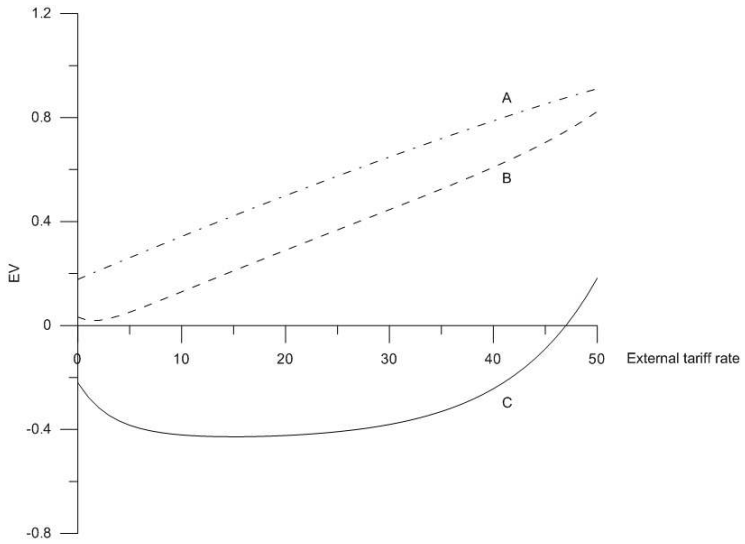

Figure 5.39 FTA and impact on welfare change in Country 1 ($\beta_1 < \beta_r$; $r \in 2,3$)

Capital income (A), government transfer (B) and consumer surplus (C) effects on welfare change in Country 1 from FTA formation, where $\beta_1 = 0.9\beta_r$ and $\beta_r = \frac{\sigma - 1}{\sigma}$; $\sigma = 8$, $r \in \{2,3\}$.

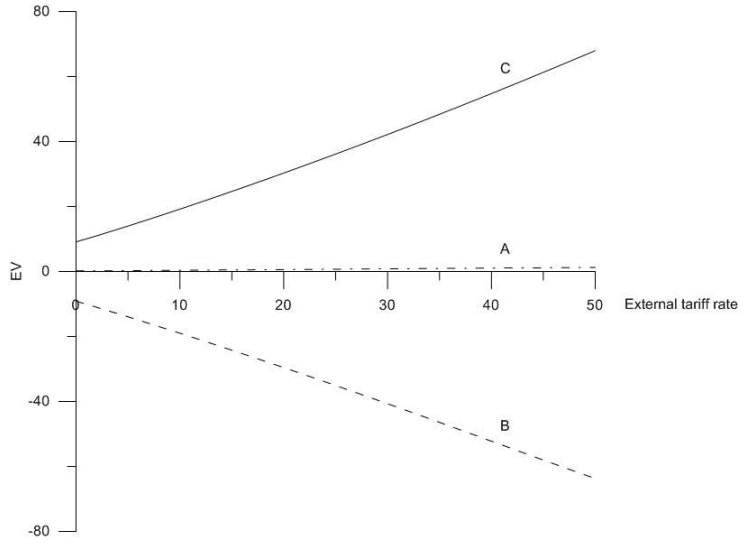

Figure 5.40 FTA and impact on welfare change in Country 2 ($\beta_1 < \beta_r$; $r \in 2,3$)

Capital income (A), government transfer (B) and consumer surplus (C) effects on welfare change in Country 2 from FTA formation, where $\beta_1 = 0.9\beta_r$ and $\beta_r = \frac{\sigma - 1}{\sigma}$; $\sigma = 8$, $r \in \{2,3\}$.

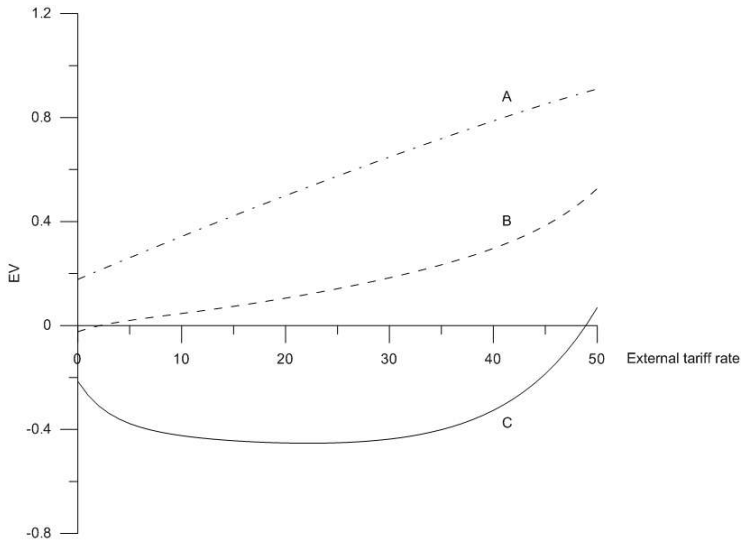

Figure 5.41 FTA and impact on welfare change in the ROW ($\beta_1 < \beta_r$; $r \in 2,3$)

Capital income (A), government transfer (B) and consumer surplus (C) effects on welfare change in the ROW from FTA formation, where $\beta_1 = 0.9\beta_r$ and $\beta_r = \frac{\sigma - 1}{\sigma}$; $\sigma = 8$, $r \in \{2,3\}$.

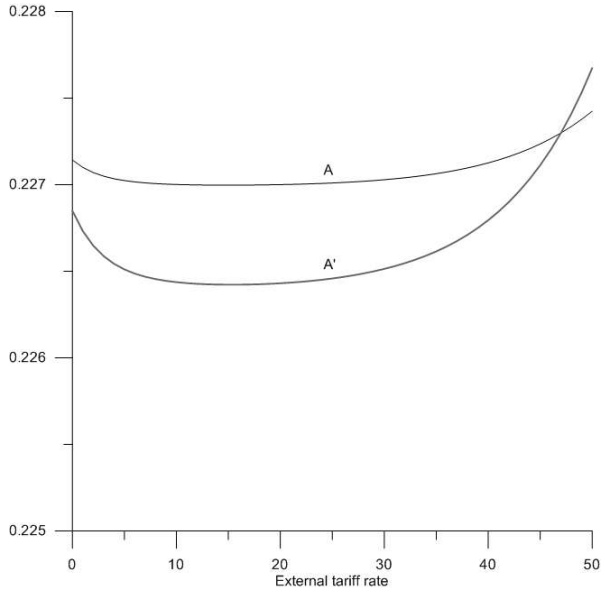

Figure 5.42 FTA and prices of *M* good ($\beta_1 < \beta_r$; $r \in 2,3$)

Individual variety prices of *M* good after FTA formation in (A) Country 1 and individual variety prices of *M* good prior to FTA formation in (A′) Country 1, where $\beta_1 = 0.9\beta_r$ and $\beta_r = \frac{\sigma - 1}{\sigma}$; $\sigma = 8$, $r \in \{2,3\}$.

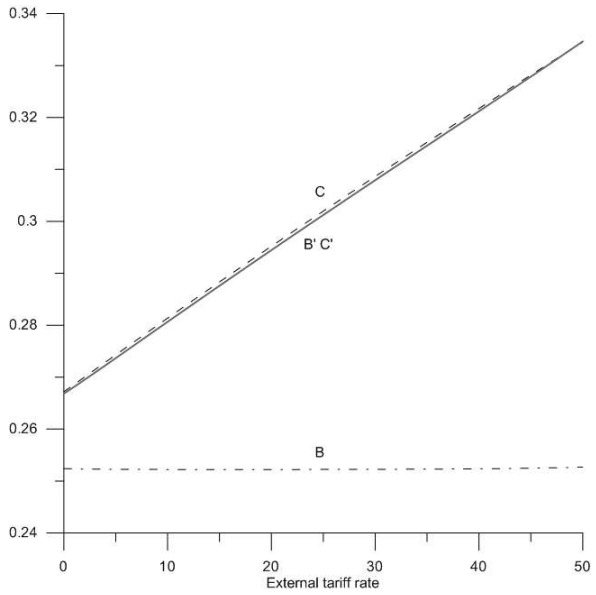

Figure 5.43 FTA and prices of *M* good ($\beta_1 < \beta_r$; $r \in 2,3$)

Individual variety prices of *M* good after FTA formation in (B) Country 2, (C) the ROW and individual variety prices of *M* good prior to FTA formation in (B′) Country 2, (C') Country 3, where $\beta_1 = 0.9\beta_r$ and $\beta_r = \frac{\sigma - 1}{\sigma}$; $\sigma = 8$, $r \in \{2,3\}$.

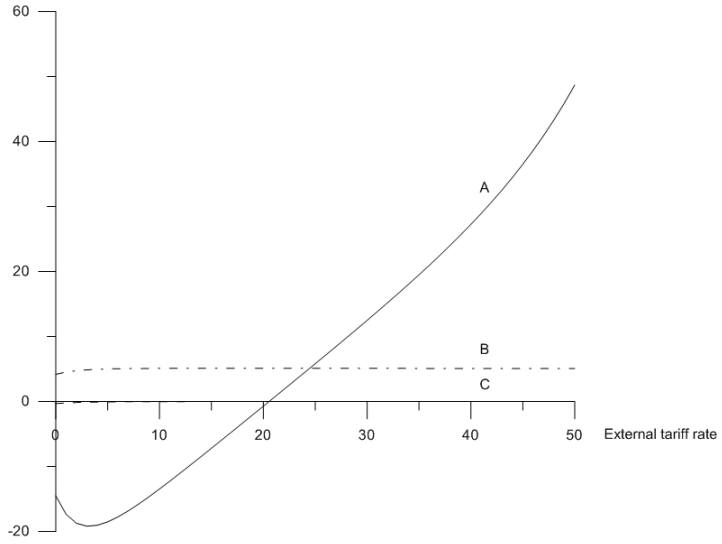

Figure 5.44 FTA and changes in demand in Country 1 ($\beta_1 < \beta_r$; $r \in 2,3$)

The change in Country 1's demands on *M* good produced in (A) Country 1, (B) Country 2 and (C) the ROW after FTA formation, where $\beta_1 = 0.9\beta_r$ and $\beta_r = \frac{\sigma - 1}{\sigma}$; $\sigma = 8$, $r \in \{2,3\}$.

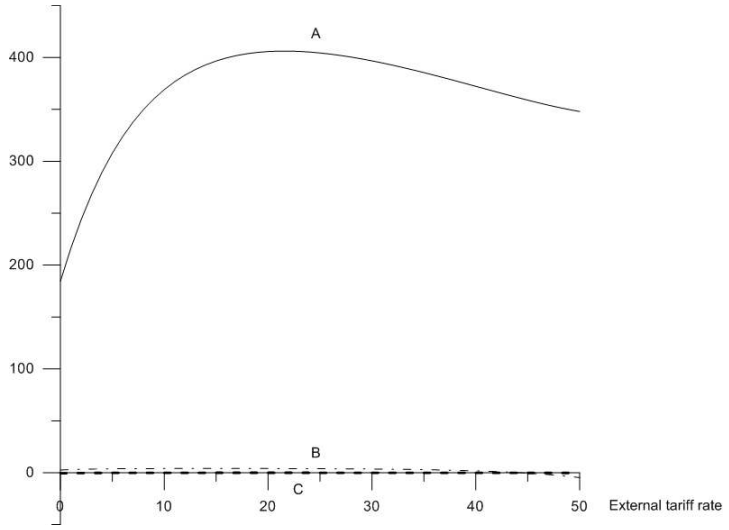

Figure 5.45 FTA and changes in demand in Country 2 ($\beta_1 < \beta_r$; $r \in 2,3$)

The change in Country 2's demands on *M* good produced in (A) Country 1, (B) Country 2 and (C) the ROW after FTA formation, where $\beta_1 = 0.9\beta_r$ and $\beta_r = \frac{\sigma - 1}{\sigma}$; $\sigma = 8,\ r \in \{2,3\}$.

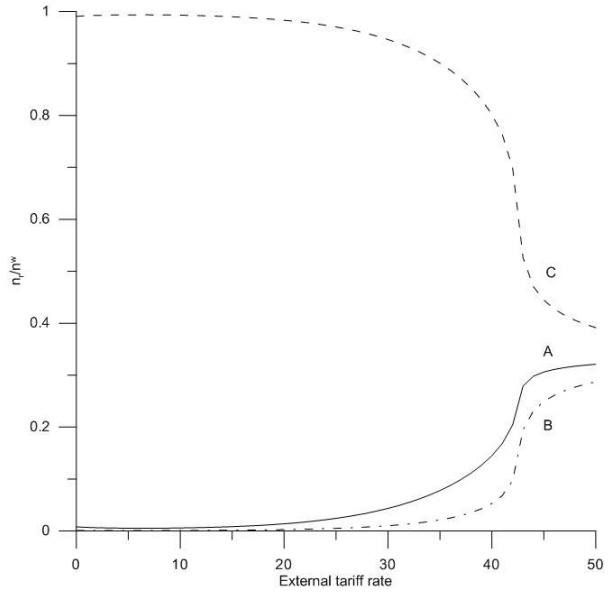

Figure 5.46 Share of firms after FTA formation ($\beta_r > \beta_3$; $r \in 1,2$)

Ratio of the number of firms in (A) Country 1, (B) Country 2 and (C) the ROW to the total number of firms in the world after the formation of FTA, where $0.9\beta_r = \beta_3$ and $\beta_r = \frac{\sigma - 1}{\sigma}$; $\sigma = 8,\ r \in \{1,2\}$.

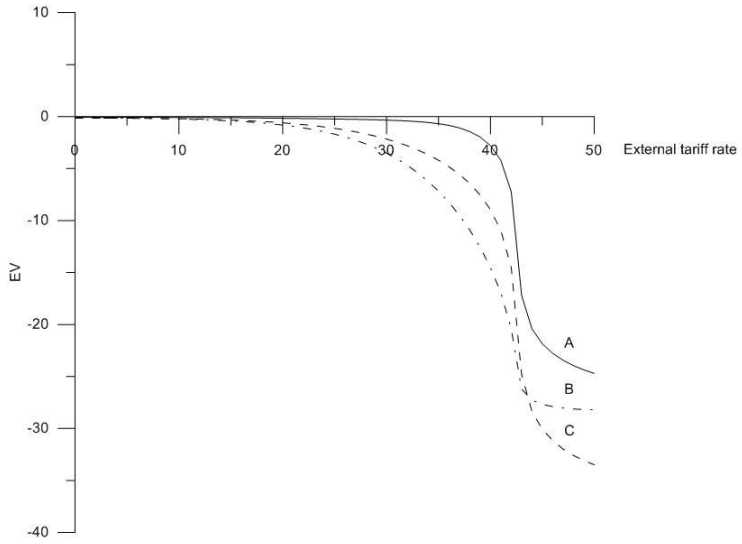

Figure 5.47 FTA and total welfare change ($\beta_r > \beta_3;\ r \in 1,2$)

Welfare change in (A) Country 1, (B) Country 2 and (C) the ROW after the formation of FTA, where $0.9\beta_r = \beta_3$ and $\beta_r = \frac{\sigma - 1}{\sigma};\ \sigma = 8, \in \{1,2\}$.

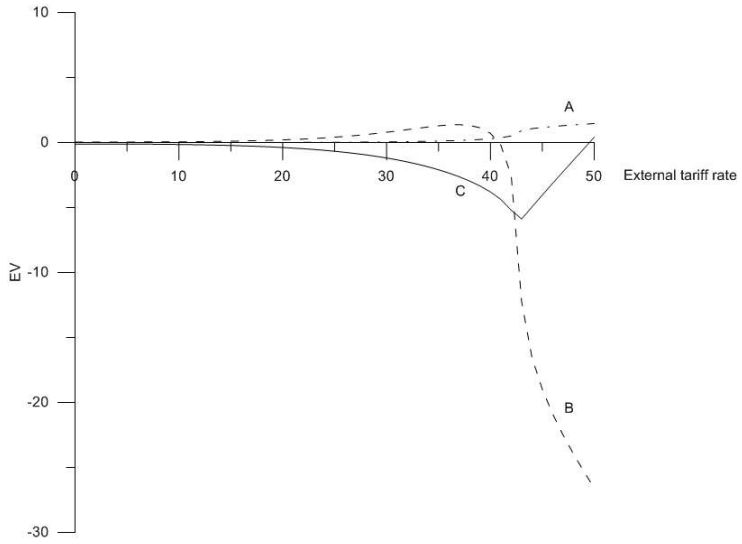

Figure 5.48 FTA and impact on welfare change in Country 1 ($\beta_r > \beta_3;\ r \in 1,2$)

Capital income (A), government transfer (B) and consumer surplus (C) effects on welfare change in Country 1 from FTA formation, where $0.9\beta_r = \beta_3$ and $\beta_r = \frac{\sigma - 1}{\sigma}$; $\sigma = 8, \in \{1,2\}$.

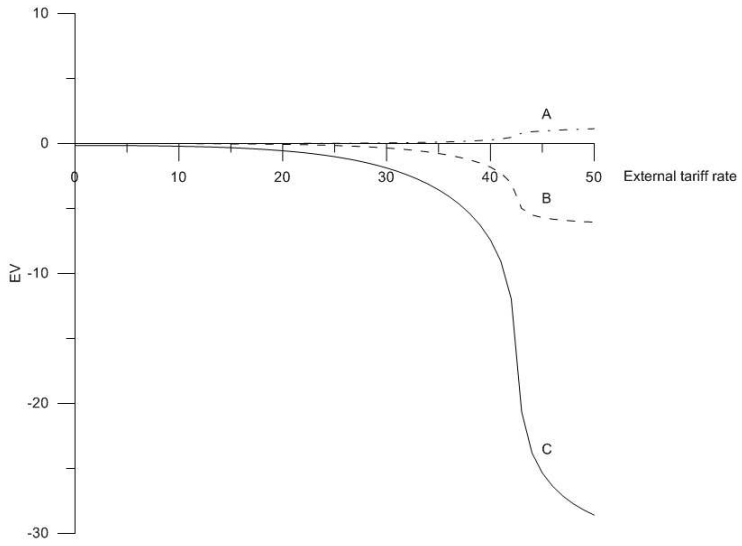

Figure 5.49 FTA and impact on welfare change in the ROW ($\beta_r > \beta_3;\ r \in 1,2$)

Capital income (A), government transfer (B) and consumer surplus (C) effects on welfare change in the ROW from FTA formation, where $0.9\beta_r = \beta_3$ and $\beta_r = \frac{\sigma - 1}{\sigma}$; $\sigma = 8, \in \{1,2\}$.

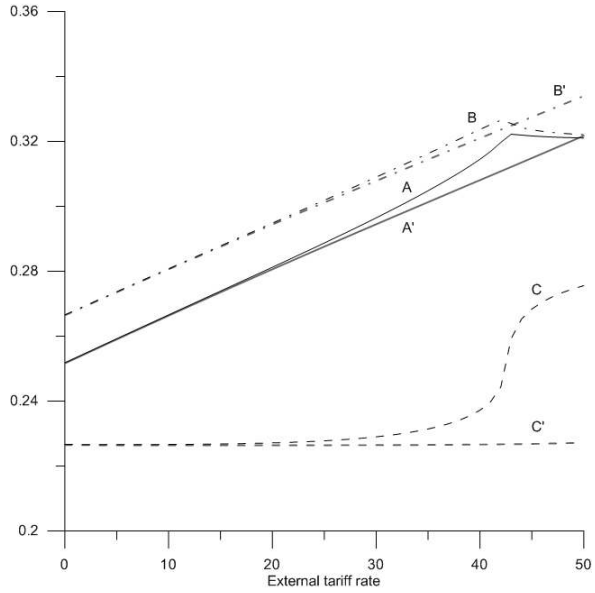

Figure 5.50 FTA and prices of *M* good ($\beta_r > \beta_3;\ r \in 1,2$)

Individual variety prices of *M* good after FTA formation in (A) Country 1, (B) 2 and in (C) the ROW, and individual variety prices of *M* good prior to FTA formation in Country (A′) 1, (B′) 2 and (C′) 3, where $\beta_1 = 0.9\beta_r$ and $\beta_r = \frac{\sigma - 1}{\sigma};\ \sigma = 8,\ r \in \{2,3\}$.

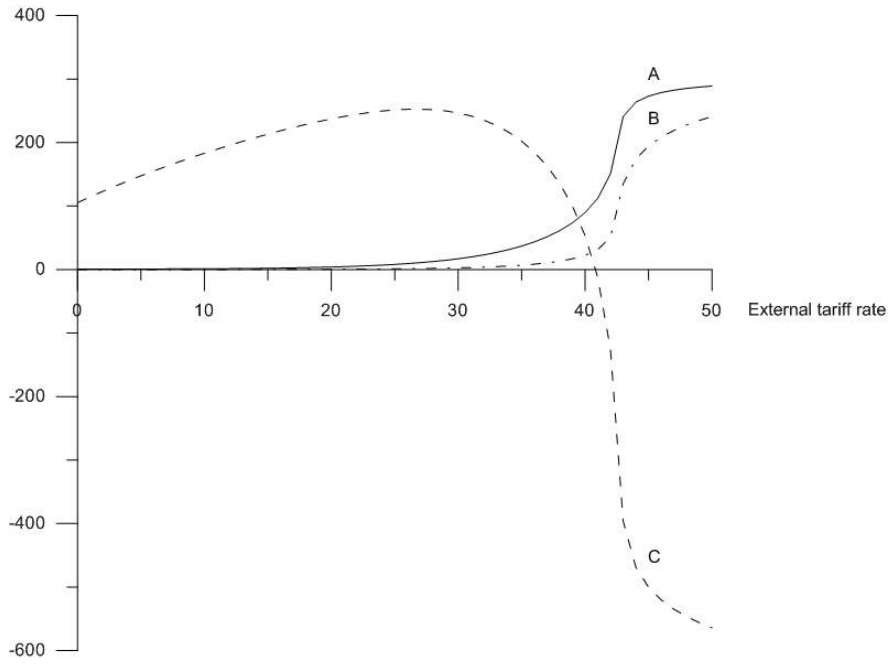

Figure 5.51 FTA and changes in demand in Country 1 ($\beta_r > \beta_3;\ r \in 1,2$)

The change in Country 1's demands on *M* good produced in (A) Country 1, (B) Country 2 and (C) the ROW after FTA formation, where $\beta_1 = 0.9\beta_r$ and $\beta_r = \frac{\sigma - 1}{\sigma}$; $\sigma = 8,\ r \in \{2,3\}$.

Chapter 6

Preferential Trade Agreements, Taxation, and Industry Location

6.1 Introduction

Increasing mobility of capital and falls in trade cost that have accompanied economic integration also give rise to incentives for countries to compete over mobile capital as investors have gained greater freedom to take advantage of and have developed a greater sensitivity to foreign economic opportunities. The more footloose nature of these investments implies that decisions about the location of businesses have become more sensitive to tax factors.

Foreign direct investment benefits host countries not only by providing direct capital financing but also by creating positive externalities via the transfer of foreign technology and know-how. Accordingly, there is a widespread perception among policymakers that FDI effects productivity improvement in host countries and enhances economic development. As a result, many countries' policies have resulted in intensification in global competition among governments to attract FDI. However, there is raising concern among policymakers that this competition may have undesirable effects, such as producing a continuous harmful increase in costly investment incentives that deteriorate countries' public finances and create market distortion in the allocation of real investment.

We know from chapter V that the formation of a PTA creates a considerable large common market within the PTA bloc. The eradication of intra-tariff between PTA member countries unambiguously diverts investments away from the ROW. In this chapter, we aim to analyse the effects of the policy responses from the ROW aimed at retaining investments after the formation of PTA. For simplification, we

assume that Country 1 and 2 choose to form a Customs Union. In a world with a fixed amount of capital, a prominent action of many countries is to utilize their fiscal policy instruments in order to attract mobile capital. Import tariffs and corporate income taxes are two main policy tools which are regularly used to this end. If the ROW's government utilizes corporate income taxes for this purpose, it may trigger intergovernmental tax competition among the ROW and the PTA member countries. On the other hand, using import tariff may not trigger such competition, since article XXIV of GATT/WTO dictates that the WTO members are allowed to enter into preferential trade agreements under the condition that the tariffs on external trade with non-CU members are not raised. Therefore, we shall specifically examine the effect of the ROW using import tariff in response to the formation of PTA without any reaction from CU member countries. Instead, we shall examine the effects of the ROW using corporate income tax in response to the formation of PTA and the plausible subsequent reaction of each PTA member, particularly in using such tax to compete over investments.

We find that raising the external tariff is not an effective policy instrument for the ROW's government to attract investments. Instead, the ROW's government may be able to improve welfare of its consumers via the reduction of its external tariff. Furthermore, a unilateral decrease in tariff by the ROW is generally Pareto improving, in the sense that both consumers in the ROW and CU area benefit from welfare gains even though the ROW will lose some of its remaining firms to CU countries. We also find that the ROW's government has no incentive to reduce its CIT rate, if the external tariffs are sufficiently high. This is because this is not an effective policy to retain investments regardless of the depth of CIT reduction. In addition, it makes the ROW's consumers suffer from welfare loss. On the other hand,

the reduction of CIT may become an effective instrument for the ROW's government to retain investments, if the external tariffs are sufficiently low. Surprisingly, the reduction of the ROW's CIT rate − at this level of external tariffs − may give rise to three possible scenarios. The first one is that both CU countries choose not to engage in intergovernmental tax competition. The second one is that both CU members engage in intergovernmental tax competition. The last one is that only one of two members of CU engages in intergovernmental tax competition, while the other keeps imposing its status quo CIT rate. To our knowledge, the last scenario has not been considered in the literature to date and goes against the standard result suggested in the literature based on the new economic geography approach as well as the basic tax competition approach, which generally propose that the reduction of CIT rate triggers a race to the bottom tax competition between countries –when trade is perfectly free. This scenario is relevant as it may help explain the investment allocation within the EU − where intra-EU trade is virtually free – in which some countries choose to impose relatively high CIT rates and are able to retain some investments within their countries, while others impose very low CIT rate and are able to attract a large portion of investments.

The chapter proceeds as follows. Section 6.2 discusses the effect of the ROW's taxation policies changed in response to a PTA formation. Section 6.3 shows the simulation results of the economic impact of a change in ROW's taxation policies. In this section, we specifically investigate the effects of either external tariff reduction or CIT reduction by the ROW, with plausible response from CU member countries. Section 6.4 concludes the chapter.

6.2 The effect of the ROW's taxationpolicies changed in response to a PTA formation

We have found in chapter V that not only does a PTA formation make PTA member countries better off, but it can also generate a welfare gain in the ROW. However, the formation of a PTA unambiguously diverts investments away from the ROW. Additionally, the ROW may be worse off at some levels of external tariffs. The loss from the PTA formation then creates an incentive for policymakers in the ROW to attempt to retain their existing investment and avoid welfare losses. In order to do so, policymakers in the ROW may consider using either their CIT or tariffs as tools to retain and/or attract internationally mobile firms. For ease of exposition, we shall focus on the case in which countries are symmetric in term of labour and capital endowments and use the same technology in production.[28] Then, starting from an initial equilibrium in which country 1 and 2 have already formed a Customs Union, we shall examine the effect of the ROW adjusting its taxation policies in response to the formation of a PTA and the plausible subsequent reactions of PTA members of using such taxes to compete over investments.

In our analysis, the objective of the government is to raise consumers' welfare by implementing a policy that aims to attract capital into the country. Given the model set-up in chapter V, this implies that the policy will ultimately determine the total capital available for production, and in turn, the number of firms operating in the country. We assume that the policy instruments available to the ROW are the external tariff rate $\tau_{s,3}$ and the CIT rate t_3. If the ROW's government uses CIT in response to the formation of a PTA, the plausible subsequent reactions of the PTA

[28] The formation of PTA – either CU or FTA – yields similar outcomes even if the sizes of country are slightly different. The reader is referred to see Chapter V its details.

members are to adjust their CIT rates, $t_r;\ r \in \{1,2\}$, in response to the ROW's action.

When the ROW's government uses the tariff rate as a tool to attract capital into the country, such policy would transmit its effects through several important channels, i.e.

(i) A change in the CES price index.

(ii) A change in prices.

(iii) A reallocation of firms across countries.

(iv) A change in government transfers.

These channels have been thoroughly discussed in Chapter V. However, if the government were to use the CIT rate as a tool to attract capital into the country, one of the channels through which such policy would transmit it effects would be different from those of a tariff, i.e.:

(v) A change in the net rate of return to capital via CIT reduction. A reduction of CIT would directly affect the net rates of return to capital. If the ROW's government reduces its CIT rate, investors from every country would receive a higher after tax return to their investment in that country. This would attract new firms to relocate to the ROW and trigger the "reallocation of firms across country" effect in **(iii)** above. However, a reduction of CIT also brings about decreases in both government revenue and consumers income. This would slightly offset the expansion of expenditure on the *M* good created by **(iii.)**.

In order to assess whether the responding action by each government is a desirable– in the sense that it serves the objective of the government to attract investments into the country and, eventually, raise social welfare, we will assess the

effects of these actions using two out of three indicators that we use in chapter V. These indicators are:

(i) The ratio of firms that locate in the country to the total number of firms in the world.

(ii) The change in social welfare.

6.3 Simulations of the economic impacts of the change in ROW's taxation policies in response to a CU formation

In this section, we use numerical simulations to present the economic impacts of a change in ROW's taxation policies. We conduct the experiment as follows. In the initial state, the economy is in equilibrium after Country 1 and 2 have formed a CU by instantaneously eradicating their intra-CU tariff rates, while maintaining the initial external tariffs on trade with the ROW. After the formation of the CU, an agglomeration of firms occurs within CU countries, particularly at intermediate levels of the external tariff – as shown in figure 6.1 which plots the ratio of the number of firms in CU countries to the total number of firms over the external tariff rate. This agglomeration may result to the disappearance of industry in the ROW, that may incentivize its policymakers to adjust taxation policies to attract investments into theirs country. We shall consider two policy experiments. In the first, we examine the use of the external tariff as a policy instrument to attract investments. Specifically, we shall look at the effect of either increasing or decreasing external tariff rates by the ROW, such that $\tau_{s,3} = \tau_{3,r} \pm \theta$ where $r, s \in \{1,2\}$, $\tau_{3,r} \in \{0,1,2,...,50\}$, $\theta \in \{1,2,...,10\}$ and $\tau_{s,3} \geq 0$. In the second case, we consider the use of capital income tax as a policy instrument to attract investments. In contrast to the previous case, we only look at the effect of decreasing CIT rates by the ROW

such that $t_3 = t_r - \xi$ where t_r is 25%, $r \in \{1,2\}$ and $\xi \in \{1,2,...,25\}$. We then allow for Country 1 and Country 2 to adjust their CIT rates, consecutively, to match the ROW's CIT rate in an attempt to stop an outflow of investments. All simulations in this section are carried out under the assumption that countries are symmetric in size and technology.[29]

6.3.1 The effects of tariff adjustment by the ROW's government

First, we consider the use of external tariffs as a policy instrument by the ROW's government to attract investments. The effects of a change in the ROW's tariff on its allocation of firms are shown in figure 6.2. As can be seen from the figure, a reduction of the ROW's tariffs may induce some firms from CU countries to migrate to the ROW, if the external tariffs are sufficiently low. However, an increase in the ROW's tariff may result in a further relocation of firms from the ROW to CU countries at this level of external tariffs. Instead, the effects of a change in the ROW's tariff on the allocation of firms across countries are reversed, if the external tariffs are at medium, high and prohibitively high levels. The intuition for this can be articulated as follows:

- When the government raises its import tariffs, the ROW's firms are more protected from international competition in their domestic market. Increasing tariffs raise the ROW's tariff revenue unless the external tariffs are prohibitively high. It will also induce the ROW's consumers to alter their spending as well as induce the ROW's firms to change the combination of the manufacturing varieties they use as intermediate inputs. Consequently, consumers and firms will increase their

[29] We choose the following values of exogenous variables and parameters: $L_r = 100$, $K_r = 100$, $\alpha = 1$, $\beta = (\sigma - 1)/\sigma$, $\gamma = 0.60$, $\mu = 0.75$, $\sigma = 8$ and $\psi = 5$.

expenditure on domestically produced goods, whilst the ROW's demand for imported goods, $M_{r,3}$ and $z_{r,3}$, $r \in \{1,2\}$, will decline. However, increasing tariffs raise the input price index, Ω_3, and this, in turn, increases a typical *M* variety price in the ROW, p_3. As a result, the ROW's exports to CU countries, $M_{3,r}$ and $z_{3,r}$, $r \in \{1,2\}$, are likely to decline.

– If the external tariff rates are sufficiently high, most firms are likely to agglomerate in CU area. If the ROW were to increase its tariffs, it may be able to attract some firms from CU counties. Higher tariffs cause a considerably increase in demands for domestically produced *M* good. Instead, an increase in a typical *M* good price causes a slight decline in the ROW's exports to CU countries, because these exports are already small at this level of tariffs. As a result, the total demand of *M* good produced in the ROW is likely to increase. On the other hand, the total demand of the *M* good produced in CU countries falls. In essence, a rise in tariffs leads to increases in the differentiated good prices in the ROW, but only to slight increase in those prices in the CU countries. As a result, this works towards an increase in total revenue and rate of return of domestic firms in the ROW. The overall effect of an increase in tariffs is then to weaken agglomeration forces in CU countries – particularly, via a backward linkages effect – which eventually results in a narrowing of the gap between rates of return of firms in the ROW and CU. This subsequently induces some of the firms in the CU area to

move to the ROW. Furthermore, the higher the external tariffs, the larger the number of firms that move to the ROW.

– However, if the external tariffs are low, firms are likely to spread between CU countries and the ROW. In this case, increasing tariffs are likely to make domestic firms worse off. At this level of tariffs, the ROW's firms use a considerable amount of imported goods from CU countries as an intermediate input. Thus, increasing tariffs will cause an increase in individual variety prices of the *M* good produced in the ROW, p_3. As a result, ROW's firms will be less competitive and suffer from decreasing demands for export, $M_{3,r}$ and $z_{3,r}$, $r \in \{1,2\}$, whilst demand for domestically produced varieties, $M_{3,3}$ and $z_{3,3}$ will slightly increase. Hence, the total demand for *M* good produced in the ROW will fall. It then follows that the rate of return of firms in the ROW decreases, because of a fall in their total revenue, while their total cost increases. An increase in individual variety prices of the *M* good produced in the ROW, p_3, also induces the CU's firms to change the combination of their basket of the manufacturing varieties used in production as an intermediate input. Therefore, demands for domestically produced *M* good in CU countries, $M_{s,r}$ and $z_{s,r}$, $s,r \in \{1,2\}$, rise. The change of input combination also leads to a slight reduction of input price indices, Ω_1 and Ω_2, as well as prices of the *M* good produced in CU countries, p_1 and p_2. The overall effect of an increase in tariffs thus works towards strengthening agglomeration forces in CU countries – specifically, via a forward

linkages effect – which results in a widening of the gap between the rates of return of firms in the ROW and CU. This subsequently induces some of the firms in the ROW to relocate to CU area.

- However, when the ROW's government reduces its import tariff, it will experience a reduction of its tariff revenue. Decreasing tariffs also directly induce the ROW's consumers and firms to increase their demands for imported goods, $M_{r,3}$ and $z_{r,3}$, $r \in \{1,2\}$, whilst their demand for domestically produced goods, $M_{3,3}$ and $z_{3,3}$, decline. A decrease in the ROW tariff will result in a decrease in input price index, Ω_3 and, consequently, a decrease in typical *M* good prices in the ROW, p_3. This will cause the ROW's export to CU countries, $M_{3,r}$ and $z_{3,r}$, $r \in \{1,2\}$, to increase and partially raise the demand for domestically produced *M* good, $M_{3,3}$ and $z_{3,3}$.
- When the external tariffs are sufficiently high, decreasing tariffs will cause a decrease in demand for domestically produced *M* good. However, this effect is partially offset by a slight increase in demand for export from the ROW. The net effect consists of a reduction in the total demand for the *M* good produced in the ROW and in an increase in that produced in CU countries – which, in turn, strengthens agglomeration forces in CU countries, particularly via a backward linkages effect. As a result, the discrepancy between the rates of return of firms in the ROW and CU widens, which subsequently induces some of the firms in the ROW to move to CU countries.

- However, when the external tariffs are sufficiently low, decreasing tariffs will cause a considerable decrease in the input price index, Ω_3 and, consequently, in the price of a typical *M* good prices in the ROW, p_3. This, in turn, works towards an increase in the demand for export as well as partially increase demand for domestically produced *M* good. As a result, the higher demand for export from the ROW overweighs the lower demand for domestically produced varieties of the *M* good. The overall effect of a decrease in tariffs is for the increase in total demand for the *M* good produced in the ROW to be considerably larger than the increase in the total demand for the varieties produced in each CU country. Therefore, a decrease in tariffs would strengthen agglomeration forces in the ROW – particularly via a backward linkages effect – which results in a narrowing of the gap between the rates of return of firms in the ROW and in the CU. This subsequently induces some of the firms in CU area to move to the ROW.
- Nevertheless, the ratios of the number of firms in each CU countries and the ROW remain relatively unchanged after the ROW adjusts its external tariff, as shown in figure 6.3 and 6.4.

Figure 6.5 and 6.6 illustrate the change in welfare in CU countries and the ROW that result from the ROW's tariff adjustment. Generally, a reduction of the ROW tariff makes CU countries and the ROW better off, even though the ROW suffers from the tariff reduction, if the external tariffs are very low. On the other hand, an increase in the ROW tariff generally makes CU countries and the ROW worse off. These results are different from the price-lowering effect of protection discussed in Venables (1985) – in an oligopolistic competition framework − and

Venables (1987), Baldwin et al. (2003 p.278) and Bagwell and Staiger (2009) – within a monopolistic competition framework. They suggest that a unilateral increase in import barrier induces firms to migrate into the country and thereby reduce domestic prices. In this case, this policy would likely be welfare improving. The main difference with our results is that the effect of agglomeration forces − which attracts a large number of firms to operate in the CU area and leaves only a small fraction of varieties to be initially produced in the ROW − and the existence of vertical linkages in the production of *M* sector – which incentivises firms to obtain inputs from CU countries − are the major factors, which cause an increase in a typical *M* good prices in the ROW. An increase in typical *M* good prices and an increase in tariffs eventually cause an increase in the ROW's price index. In this case, the negative effect of an increasing price index − after the ROW's tariff increases − outweighs the small positive effect of firms relocation, which results in decreasing welfare.

The decomposition of the effect of the ROW's tariff adjustment on consumers' welfare change in each CU country is shown in figures 6.7 to 6.9, which show that a decrease in ROW tariff generally generates a positive capital income effect, while increasing tariff generates a negative capital income effect. If the external tariffs are sufficiently high, increasing tariff may produce a positive capital income effect. However, a change in capital income has only a slight effect on total welfare. If the external tariffs are sufficiently low, an increase in tariff may produce a positive government transfer effect, whilst a decrease in tariff generates a negative government transfer effect. However, these effects are reversed when the external tariffs are at intermediate, high and prohibitive high levels. When the external tariffs are at low, high and prohibitively high levels, a decreasing tariff generates a positive

consumer surplus effect. While, an increasing tariff generates a negative consumer surplus effect, if the external tariffs are at intermediate level. These effects are reversed, when government increases its tariff. The intuition for these can be articulated as follows:

- An increasing in ROW tariff generally raises the intermediate input price index in the ROW, which causes the *M* good variety prices in the ROW to rise. Consequently, the ROW's demand for imported *M* good produced in CU countries declines, and this eventually has a knock on effect on decreasing tariff revenue in both CU member countries. Therefore, an increase in ROW tariff generates a positive government transfer (TR) effect, while decreasing it generates a negative effect. However, these effects are reversed, when the external tariffs are very low.
- Increasing tariff, which results in some firms relocating to the ROW, generates a negative consumer surplus (CS) effect, where the external tariffs are either very low or sufficiently high. On the other hand, decreasing tariff makes the ROW's consumers better off, where the external tariffs are either very low or sufficiently high. However, these effects are reversed, where the external tariff are low.

The decomposition of the effect of the ROW's tariff adjustment on welfare change in the ROW shows that a change in capital income has only a slight effect on total welfare. The pattern of change in welfare in the ROW is qualitatively similar to that for CU countries. The changes in government transfer and consumer surplus effects are illustrated in figure 6.10 to 6.11, which show that a decrease in ROW tariff generates a negative government transfer effect and a positive consumer

surplus effect, whilst an increase in ROW tariff generally generates a positive TR and a negative CS effects. However, if the external tariffs are sufficiently high, increasing tariff may produce a negative TR effect. The intuition for this is as follows:

- An increase in ROW tariff raises tariff revenue to the ROW's government, which also generates a positive TR effect that raises consumers' welfare. The opposite is true when the government decreases its tariff. However, if the external tariffs are prohibitively high, the change in tariff – regardless of whether it is positive or negative – causes a welfare loss. This is because − at this level of tariffs − increasing tariff will discourage consumers to spend on import, which leads to a drop in tariff revenue. On the other hand, decreasing tariff induces consumers to increase demand of import goods. However, the increase in tariff revenue resulting from a higher demand is dominated by the fall in tariff revenue caused by the lower tariff rate.
- An increase in ROW tariff rate, which results in an increasing price index in the ROW, generates a negative consumer surplus (CS) effect. On the other hand, decreasing tariff lowers price index, which makes the ROW's consumers better off from the CS effect.

In conclusion, the external tariff is not an effective policy instrument for the ROW's government to attract investments, if firms have already agglomerated in the CU area. The number of relocating firms is relatively negligible, when the ROW's government increases its tariff. An increase in tariff directly leads to an increase in the price index; this effect is offset, however, by an increase in the number of domestic firms that work towards a reduction in the price index. Consequently, the

ROW's consumers suffer from a welfare loss. On the other hand, a unilateral decrease in tariff by the ROW is generally Pareto improving, in the sense that both consumers in the ROW and CU area experience a welfare gain. Even though, the ROW will lose some of its remaining firm to CU countries.

6.3.2 The effects of capital income tax reduction

In this subsection, we turn to consider the use of capital income tax by the ROW as a policy instrument to attract investments in response to the agglomeration of firms in CU area. In particular, we examine the effects of decreasing CIT rates by the ROW to attract investments into the country. We then study the subsequent responses by CU members aimed at preventing an outflow of investments as well as improve their consumer welfare. In essence, we are considering tax competition in capital income taxation between CU countries and the ROW.

The tax competition between countries can be represented by sequential steps with the following order of moves:

Stage 0 Country 1 and Country 2 form a customs union by implementing an instantaneous eradication of the intra-CU tariff rate, while maintaining the original tariffs on trade with the ROW.

Stage 1 The ROW reduces its CIT rate such that $t_3 = t_r - \xi$ and $\xi \in \{1, 2, ..., 25\}$, where all countries impose their initial CIT rates, t_r, at 25 percent.

Stage 2 Country 1 reduces its CIT rate to match the ROW's rate.

Stage 3 Country 2 reduces its CIT rate to match those of Country 1 and the ROW.

6.3.2.1 The first stage: capital income tax reduction by the ROW

After the formation of the CU, the ROW may consider reducing its CIT rate to stop the outflow of investments from the country. The reduction of the ROW's CIT rate will have an effect on the allocation of firms, as shown in figure 6.12, which shows that the reduction of the ROW's CIT induces a considerable number of firms to move to the ROW, if the external tariff rates are either at low or at prohibitive high levels. On the other hand, this policy attracts a negligible number of firms to the ROW, if the external tariffs are at intermediate and high levels. The intuition for this is that:

- A fall in CIT directly increases after-tax returns to capital of firms operating in the ROW. This induces firms to relocate to the ROW. However, as our simulations' results show, a reduction of CIT attracts a negligible number of firms to the ROW, if the external tariffs are at intermediate and high level, regardless the level of CIT reduction. Therefore, the ratios of the number of firms in each CU countries and the ROW are relatively unchanged. At these levels of external tariff rates, the after tax rate of return from firms located in CU countries is still higher than that of in the ROW, even though the ROW's CIT rate is zero percent.
- On the other hand, this policy induces a considerable number of firms to move to the ROW, if the external tariff rates are either at low or at prohibitive high levels. The lower the ROW's CIT rate, the more firms emigrate from CU countries, as shown in figure 6.13 and 6.14.

Figures 6.15 and 6.16 show the change in welfare in CU countries and the ROW, after the reduction of the ROW's CIT rate. The reduction of CIT by the ROW

causes a decrease in the level of welfare in both CU countries and the ROW, if the external tariff rates are at intermediate, high and prohibitive high level. However, the ROW's consumers would benefit from welfare gains, if the external tariffs are low. At very low external tariff rates, if the level of CIT rate in the ROW is approaching zero, the ROW's consumers would suffer from a welfare loss, while the consumers in EU area would experience a welfare gain.

The decomposition of the effect of the ROW's CIT reduction on welfare change in each CU country is shown in figure 6.17 to 6.19:

- Generally, decreasing the ROW's CIT generates a positive capital income effect to CU's consumers. The larger the reduction of the ROW's CIT rate, the higher the welfare increases. A change in capital income has a considerable effect on total welfare, if the external tariffs are low and the ROW's CIT rate approaches zero. This gain originates from the fact that investors move most of their investments from CU area – where the rate of return from their investments is subject to a 25 percent CIT rate − to the ROW where the low CIT rate yields a higher after tax return.
- On the other hand, the reduction of the ROW's CIT rate creates a slight positive capital income effect in CU countries, if the external tariffs are either intermediate or high. Even though the reduction of the ROW's CIT rate narrows the gap between the after-tax rates of return from firms operating in CU area and that of the ROW. However, the after-tax rate of return from firms operating in CU countries is still higher than those in the ROW when the CIT in the ROW is zero.

- When the external tariffs are low, decreasing the ROW's CIT rate − that leads to a relocation of a considerable number of firms to the ROW − generates a considerably negative TR effect to CU's consumers. This negative effect mainly results from the loss of CIT revenue. Even though this loss of revenue is partially offset by the gain from tariff revenue. As a result, the larger the number of firms that gather in the ROW, the deeper the loss of welfare from a negative TR effect.
- At the higher level of the external tariffs, decreasing the ROW's CIT rates hardly changes the allocation of firms. Therefore, the TR effect turns to be slightly positive, if the external tariffs are at intermediate level. Instead, the effect is slightly negative if the external tariffs are high and prohibitive high.
- Generally, the reduction of the ROW's CIT generates a negative CS effect in CU area. The lower the ROW's CIT rate, the larger is the negative CS effect in the CU area. This is because the reduction of the ROW's CIT attracts firms to move to the ROW, which eventually leads to an increase in price indices in CU countries.

The decomposition of the effect of the ROW's tariff adjustment on welfare change in the ROW is shown in figure 6.20 and 6.21:

- Generally, decreasing the ROW's CIT rate generates a positive capital income effect to the ROW's consumers, which is comparable to those of in CU countries.
- The change in welfare in the ROW as a result of the TR effect is qualitatively similar to that for CU countries. The main difference is that the TR effect in the ROW is relatively larger as not only does the

negative effect results from a drop in CIT revenue, but also from a drop in tariff revenue.

- The reduction of the ROW's CIT generates a CS effect that is opposite from that for CU countries. CS effect is positive and significant in magnitude, if the external tariffs are very low or prohibitively high, whilst, the CS effect is negative, if the external tariffs are intermediate and high. The negative effect occurs because the positive effect of an increase in the number of firms in the ROW − that leads to a decrease in price index − is dominated by the negative effect of an increase in prices of imported goods − that leads to an increase in price index.

These results suggest that a reduction of the ROW's CIT rate is not an effective policy to induce firms to move from CU countries if the external tariff rates are at intermediate and high levels. However, this policy instrument would be very effective to attract firms from CU countries, if the external tariff rates are at either low or prohibitive high levels. The lower the ROW's government reduces its CIT rate, the more firms will migrate from CU countries.

6.3.2.2 The second stage: a capital income tax reduction by Country 1 to match the ROW's rate

After the ROW reduces its CIT rate, Country 1 may consider reducing its CIT rate to stop the outflow of investments from the country. The reduction of Country 1's CIT rate has an effect on the allocation of firms as shown in figure 6.22 - 6.24:

- A fall in CIT to match that of the ROW directly increases after-tax returns to capital for firms operating in Country 1. Then, after-tax return to capital of Country 1's firms is the highest among those of firms in other countries. This triggers a reallocation of firms across countries.

Generally, firms from both Country 2 and the ROW start relocating to Country 1. The deeper the CIT rate reduction the more the firms immigrate to Country 1.

- Noticeably, the absence of trade barrier between CU member countries equalizes both the cost of production and demand for the product of firms operating in both CU countries. Therefore, not only does Country 1's CIT rate reduction benefit firms operating in Country 1, but it can also raise rate of return of firms operating in Country 2. Therefore, pre-tax rates of return from Country 1's firms and Country 2's firms would be identical.
- As our simulations' results show, not only do firms move from the ROW to Country 1, in some conditions firms also move to Country 2. Specifically, this happens where the external tariffs are very low and Country 1's CIT rate approaches zero. This corresponds to the point where the reduction of the ROW's CIT rate attracts most of firms to agglomerate in the ROW in the first stage.
- In conclusion, the reduction of Country 1's CIT rate induces most firms to agglomerate in Country 1, where the external tariffs are at intermediate and high level. Country 2 still leaves with small number of firms operating in the country. While firms almost absent from the ROW. However, the allocation of firms tends to disperse, if the external tariffs are either low or prohibitive high.

Figures 6.25 to 6.27 show the change in welfare in Country 1, Country 2 and the ROW, respectively, after the reduction of Country 1's CIT rate to match that of the ROW. The reduction of CIT by Country 1 generally causes a decrease in the

level of total welfare in both CU countries. However, such reduction may generate an increase in welfare in Country 1, if the external tariffs are low, while Country 2 may also experience an increase in welfare, if the external tariffs are low and Country 1's CIT rate is very low. The reduction of Country 1's CIT rate can also generate a positive externality that causes an increase in welfare in the ROW, if the external tariffs are sufficiently high. While both CU countries may benefit from Country 1's CIT reduction, the ROW, suffers from such policy, if the external tariffs are low.

The decomposition of the effect of country 1's CIT reduction on welfare change in each CU country is shown in figure 6.28 to 6.31:

- Generally, decreasing Country 1's CIT rate only creates a slight change in welfare via a capital income effect. A change in capital income generates a slight negative effect on welfare, if the external tariffs are at intermediate, high and prohibitive high level. The higher the external tariffs in conjunction with the lower the CIT rate in country 1, the larger the welfare loss. On the other hand, a change in capital income generates a slight positive effect on welfare, if the external tariffs are low. The highest welfare gain from capital income effect corresponds to the point where the reduction of Country 1's CIT rate reverses the agglomeration from the ROW to Country 1.
- The absence of trade barrier between CU member countries equalizes price indices in both CU countries even though the larger fraction of firms operates in Country 1. Therefore, all CU member countries would have an identical change in welfare by the CS effect.
- The reduction of Country 1' CIT rate affects the change in the allocation of firms, particularly between CU member countries, when

external tariffs are at an intermediate level. However, it hardly affects the number of firms in the ROW. Hence, at these tariff levels, the CS effect generates only a negligible positive effect on the change in welfare.

- On the other hand, the CS effect generates a considerable effect on welfare gain, where the external tariffs are either low or high. If the external tariffs are high or prohibitive high, the larger the reduction of Country 1's CIT rate, the higher the level of welfare gains from CS effect. If the external tariffs are low, the CS effect would create a considerable level of welfare gain at the point where the reduction of Country 1's CIT rate reverses the agglomeration from the ROW to Country 1.
- Because the difference between the change in the number of firms in Country 1 and Country 2 – after a reduction of Country 1's CIT rate, the welfare change caused by the TR effect in both CU member countries are slightly different. A partial reduction of Country 1's CIT rate firstly yields a positive TR effect. However, the larger the reduction the smaller the gain in welfare is. Then the TR effect turns to be negative, if the government keeps reducing its CIT rate. The larger the reduction the deeper the welfare loss is. However, this decline in welfare is smaller, if the external tariffs are low. The TR effect in Country 2 displays a comparatively similar to that of Country 1, though it has a smaller magnitude.
- The capital income effect on welfare change in the ROW displays a closely similar pattern to those of CU member countries. The difference

stems from the difference in the ratio of price index prior to and after Country 1's CIT reduction.

- The CS effect in the ROW is slightly positive, if the external tariffs are either intermediate or high. The CS effect in the ROW turns to be negative, where the external tariffs are prohibitive high. At this level of tariffs, the deeper the reduction the larger the loss in welfare is. The CS effect also generates a considerable welfare loss, where the external tariffs are low and Country 1's CIT rate approach zero. This corresponds to the point where the reduction of Country 1's CIT rate reverses the agglomeration from the ROW to Country 1.
- The TR effect generally results in welfare gains in the ROW. The gain mainly originates from increasing tariff revenue in the ROW after firms migrate from the ROW. The TR effect only generates a negligible welfare gain in the ROW, where the external tariffs are intermediate and high. However, the TR effect generates a considerable welfare gain, where the external tariffs are prohibitive high. The deeper the reduction of Country 1's CIT rate the larger the gain in the ROW's welfare is.
- On the other hand, the TR effect turns out to be negative, if the external tariffs are low. However, if Country 1's CIT rate approach zero, the TR effect may generate a considerable welfare gain in the ROW. This gain also corresponds to the point where the reduction of Country 1's CIT rate reverses the agglomeration from the ROW to Country 1.

A reduction of Country 1's CIT rate is an effective policy to induce firms to move to the country, particularly when the external tariff rates are low. However, this policy instrument would benefit consumers in Country 1 only if the external tariff

rates are at either low or prohibitive high levels. A reduction of Country 1's CIT rate may benefit another CU member country if this policy reverses the agglomeration from the ROW to Country 1.

6.3.2.3 The third stage: capital income tax reduction by Country 2 to match those of Country 1 and the ROW

After the reduction of Country 1's CIT rate, Country 2 may also consider reducing its CIT rate to stop the outflow of investments from the country. The reduction of Country 2's CIT rate has an effect on the allocation of firms as shown in figure 6.34 - 6.35:

- A fall in CIT to match those of Country 1 and the ROW will equalize CIT rates across countries. This will directly increases after-tax returns to capital of firms operating in Country 2 to match those of firms in Country 1. This would attract investments from both Country 1 and the ROW into Country 2.
- This eventually re-establishes the initial allocation of firms prior to the CIT reduction by the ROW. Country 1 and Country 2 will have an equal share of firms operating in their countries. A full agglomeration occurs in CU countries, particularly at intermediate levels of the external tariff. While firms tend to disperse across countries, where the external tariffs are either low or prohibitive high.

Figures 6.36 to 6.38 show how welfare changes in Country 1, Country 2 and the ROW after the reduction of Country 2's CIT rate in the third stage, respectively. The reduction of CIT by Country 2 generally causes a decrease in the level of welfare in Country 1. However, Country 1 may benefit from the reduction, only if the external tariffs are sufficiently high and all countries only partially reduce their

CIT rates. This reduction also generally harms consumers in Country 2. The deeper the reduction the more Country 2's consumers are worse-off. However, Country 2's consumers may experience a welfare gain from the reduction, only if all countries partially reduce their CIT rates and the external tariffs are either very low or prohibitive high. On the other hand, the ROW would generally benefit from this reduction. The deeper the reduction the higher the welfare gain is in the ROW. However, the ROW may experience welfare loss, if the external tariffs are low.

The decomposition of the effect of country 1's CIT reduction on welfare change in CU countries and the ROW are shown in figure 6.39 to 6.44:

- A decrease in Country 2's CIT rate only creates a slight change in welfare in every country via a capital income effect. These effects are also qualitatively similar to that which occurs in the second stage. Specifically, the CS effects that occur in both CU countries are identical.
- On the other hand, TR effects are different between both CU countries because of the difference between the number of relocating firms in both countries. Generally, the TR effect causes a reduction of welfare in both CU member countries. The level of welfare loss in Country 1 is the largest, if all countries partial reduce their CIT rates. In Country 2, the lower the CIT rate the larger are the welfare losses experienced by consumers. However, Country 2 may benefit from a slight positive TR effect, if the external tariffs and the CIT reduction are both very low.
- In the ROW, the CS effect generally causes a slight increase in welfare, if the external tariffs are at low, intermediate and high level. However, the CS effect may cause a slight welfare loss, if the external tariff and

all countries CIT rates are very low. When the external tariffs are sufficiently high, the CS effect turns out to be negative. At this level of tariffs, the larger the reduction of CIT rate the lower the level of welfare losses from a negative CS effect in the ROW.

- The reduction of Country 2's CIT rate may generate a slightly positive TR effect in the ROW, if the external tariffs are sufficiently high. The gain mainly originates from increasing tariff revenue after firms migrate from the ROW. Specifically, the TR effect generates a considerable welfare gain, when the external tariffs are prohibitively high. However, the TR effect may turn out to be negative, if the external tariffs are slow.

A reduction of Country 2's CIT rate is an effective policy to induce firms to move to Country 2. Most of the migrating firms come solely from another CU member country, particularly if the tariffs are at intermediate level. However, this policy attracts firms from another CU country as well as the ROW, if the tariffs are either low or high. However, this policy instrument would benefit consumers in Country 2 only if the external tariff rates are either at very low or prohibitive high level and all countries partially reduce their CIT rates.

The simulation results suggest that tax competition between the ROW and CU member countries may occur, particularly if the external tariffs are sufficiently low. The level of external tariffs and the size of CIT reduction by the ROW that result in firms delocation and trigger intergovernmental tax competition are shown by area A, B and C in Figure 6.45. In these areas, the reduction of the ROW's CIT rate will make consumers in Country 1 and 2 worse off. The reduction of the ROW's CIT rate that falls in area A will trigger both Country 1 and 2 to engage in

intergovernmental tax competition. In doing so, governments in Country 1 and 2 may improve their consumers' welfare by reducing their CIT rate to compete against other countries.

On the other hand, the reduction of the ROW's CIT rate that falls in area B and C will trigger Country 1's government to reduce its CIT rate. Then tax competition between the ROW and Country 1 − which occurs under area B − will cause Country 2's consumers to suffer from welfare loss. However, Country 2's government will keep imposing its initial CIT rate because the reduction of its CIT rate will further harm its consumers. Nevertheless, the reduction of Country 1's CIT rate to compete against the ROW that falls under area C will create a positive externality, which also improves welfare of Country 2's consumers. In this area, Country 2's government will also keep imposing its initial CIT rate because the reduction of its CIT rate will make its consumers worse off. Therefore, in area B and C, the reduction of the ROW's CIT rate will trigger tax competition between the ROW and Country 1 only. This is contrary to the result from the literature based on new economic geography approach as well as the basic tax competition approach, which normally suggest that the reduction of CIT rate triggers a race to the bottom tax competition between Countries – if trade is perfectly free.[30] Our result may contribute to explain the investment allocation within the EU − where intra-EU trade is virtually free – that is the simultaneous co-existence of countries in the EU that choose to impose relatively high CIT rates and others that impose very low CIT rate..

In area D, the reduction of the ROW's CIT rate causes firms delocation and makes consumers in Country 1 and 2 suffer from welfare losses. However, in this

[30] The interested reader is referred to Baldwin, et al. (2003 p.397) for the discussion of the effect using new economic geography approach and Wilson (1999) for the discussion of the effect using basic tax competition approach

area there is no intergovernmental tax competition, because it will harm consumers in both Country 1 and 2 further.

Moreover, if the external tariffs are sufficiently high, the ROW's government has no incentive to reduce its CIT rate. At this level of tariffs, a CIT reduction is not an effective policy to attract investments into the ROW. This is because the presence of strong agglomeration forces, which turn mobile capital into a quasi-fixed factor. This is the common effect found in tax competition literature using new economic geography approach e.g. Baldwin and Krugman (2004), Kind et al. (2000) and Ludema and Wooton (2000). In addition, it will make the ROW's consumers suffer from welfare loss. This would occur if the ROW's government reduces its CIT rate – which would take us into area E. At this level of tariffs, CU countries may be able to impose a higher CIT rate than the ROW, as long as the rate is not too much higher. While the ROW may choose its CIT rate unconstrained from an attempt to attract investments, which is similar to the scenario that is suggested by Baldwin and Krugman (2004). Finally, if the external tariffs are very low, the ROW's government will keep its CIT rate above the rate in area F. This is because those rates will make consumers suffer from welfare loss, despite investments move into the ROW.

6.4 Conclusion

An eradication of intra-tariff between PTA member countries always diverts investments away from the ROW. In this chapter, our aim was to address the question of what the effects and consequences of the response from the ROW to retain investments are. In particular, we limited the scope of our investigation to the use by the ROW of either import tariff or corporate income tax to respond to the

formation of customs union by Country 1 and 2. We assumed that a change in the ROW's import tariff does not trigger intergovernmental tariff competition. This is because article XXIV of the GATT/WTO dictates that the WTO members are allowed to enter into preferential trade agreements under the condition that the tariffs on external trade with non-CU members are not raised. On the other hand, we allow Country 1 and 2 to adjust their CIT rate in response, if the ROW chooses to adjust its CIT rate.

Our results suggest the external tariff is not an effective policy instrument for the ROW's government to attract investments, when firms already agglomerate in CU area. The number of relocating firms is relatively negligible, when the ROW's government increases its tariff. Additionally, the ROW's consumers may suffer from welfare loss. On the other hand, a unilateral decrease in tariff by the ROW is generally Pareto improving, in the sense that both consumers in the ROW and CU area enjoy a welfare gain. Even though, the ROW will lose some of its remaining firm to CU countries.

If CIT is used as a policy instrument, we find that the reduction of the ROW CIT rate may produce ambiguous results, which depend on the level of external tariffs as well as the depth of CIT reduction. If the external tariffs are sufficiently high, CIT is not an effective instrument for the ROW's government to retain investments regardless of the depth of CIT reduction. In addition, it makes the ROW's consumers suffer from a welfare loss. Therefore, the ROW's government has no incentive to reduce its CIT rate at this level of external tariffs.

On the other hand, CIT may become an effective instrument for the ROW's government to retain investments, if the external tariffs are sufficiently low. Furthermore, a reduction of CIT generates welfare gain for the ROW's consumers.

Additionally, at the low level of external tariffs, three possible response scenarios from CU countries may arise. In the first, both CU countries choose not to engage in intergovernmental tax competition. In the second, both members of the CU engage in intergovernmental tax competition. In the last, only one of the two members of a CU engage in intergovernmental tax competition, while another member keep imposing its initial CIT rate. To our knowledge the last scenario has not been considered in the literature to date and goes against the standard result from the literature based on the new economic geography approach as well as the basic tax competition approach, which generally suggest that the reduction of CIT rate triggers a race to the bottom tax competition between countries – when trade is perfectly free. The underlining reason for this asymmetric scenario to arise is that if one of the two members of a CU engage in intergovernmental tax competition, firms in the ROW are likely to relocate to CU area, especially to agglomerate in this country. Consequently, this country loses a considerable amount of revenue from CIT and tariff. Nonetheless, consumers enjoy welfare gain as a result of a decreasing price index. In addition, the existence of vertical linkages in the production of *M* sector – which incentivises firms to obtain inputs from another CU country – gives the high CIT member country the possibility to retain some firms to operate in the country. Then the absence of trade barrier between CU member countries equalizes price indices in both CU countries even though the larger fraction of firms operates in the low CIT member Country. Thus, not only do consumers in the high CIT member country enjoy welfare gain as a result of decreasing price index, but also from an increasing income from government transfer as well. Therefore, the government of the high CIT member country does not have any incentive to engage in intergovernmental tax competition, if the reduction of its CIT causes a reduction in tax revenue and eventually reduces consumers'

welfare. This scenario is relevant as it may help explain the investment allocation within the EU − where intra-EU trade is virtually free – as to why some countries in the EU choose to impose relatively high CIT rate and are still able to retain investments within their countries, while several other members impose very low CIT rates. It is worth noting that the methodology used in section 6.3.2 limits the generality of our conclusions, because the possible policy choices examined in that section might not represent optimal responses for either member of the CU. Therefore, an immediate extension to this section that is worth considering for future research is the incorporation of a game theoretic approach based on optimal responses, in an attempt to explore the generality and applicability of the results.

Appendix

6-A Figures

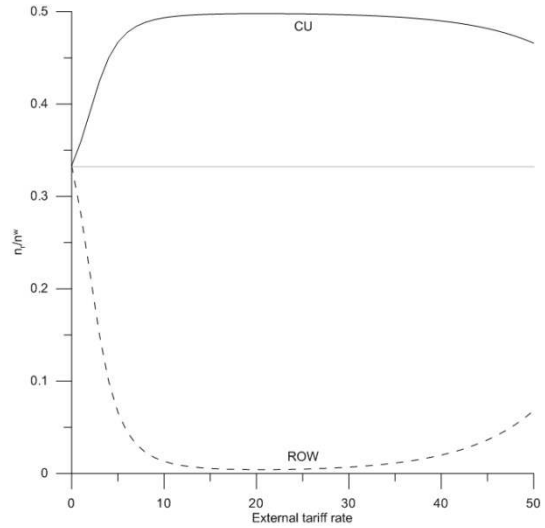

Figure 6.1 PTA and share of firms

Ratio of the number of firms in CU countries and the ROW to the total number of firms in the world after the formation of FTA.

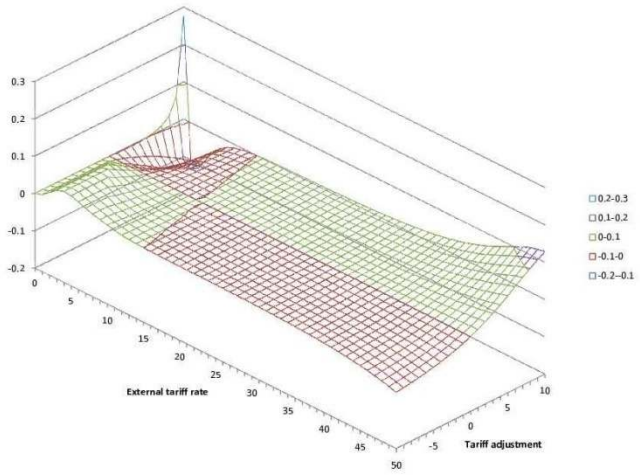

Figure 6.2 Tariffs reduction and change in the ratio of firms in the ROW

Change in the ratio of the number of firms in the ROW to the total number of firms in the world after the ROW adjusts its tariff rate.

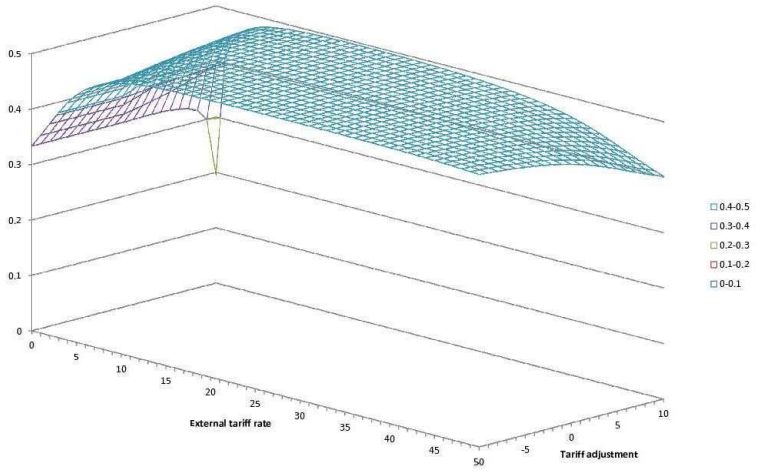

Figure 6.3 Tariffs reduction and share of firms in CU countries

Ratio of the number of firms in each CU country to the total number of firms in the world after the ROW adjusts its tariff rate.

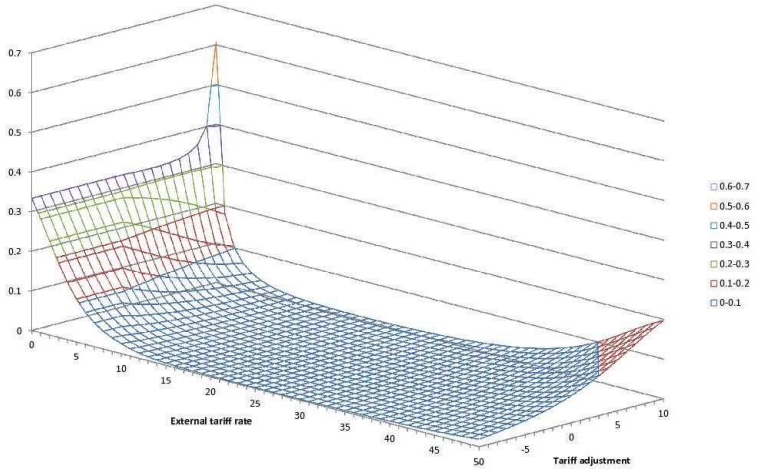

Figure 6.4 Tariffs reduction and share of firms in the ROW

Ratio of the number of firms in the ROW to the total number of firms in the world after the ROW adjusts its tariff rate.

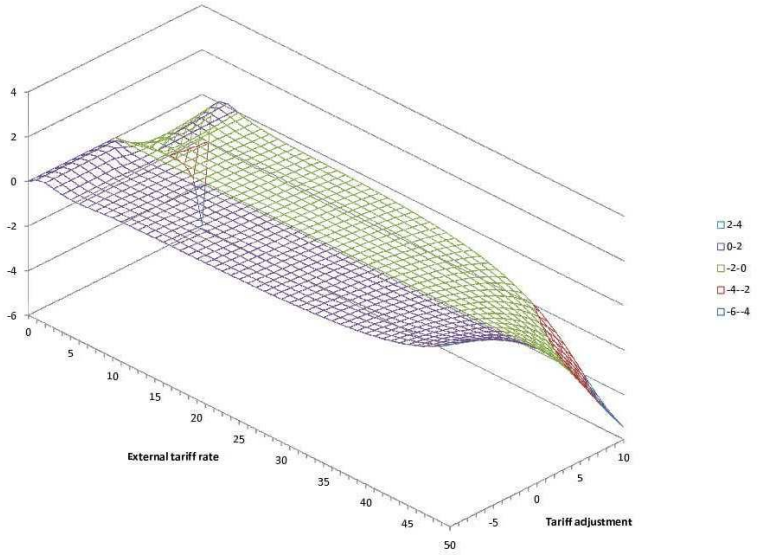

Figure 6.5 Tariffs reduction and total welfare change in CU countries

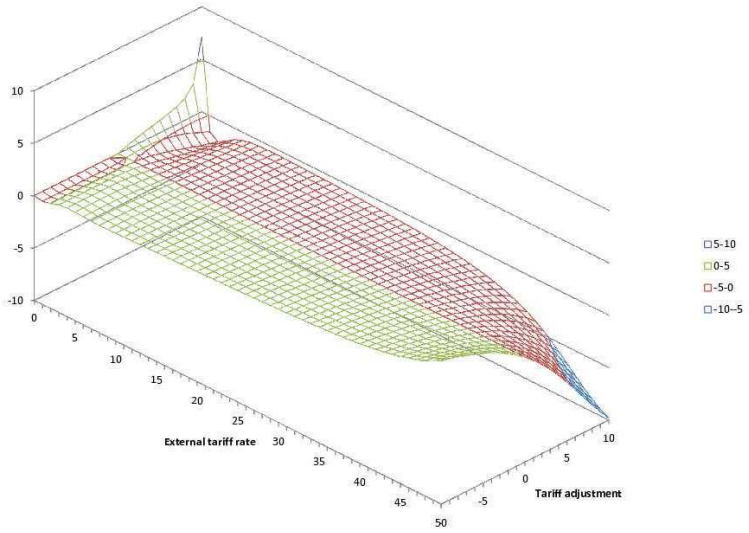

Figure 6.6 Tariffs reduction and total welfare change in the ROW

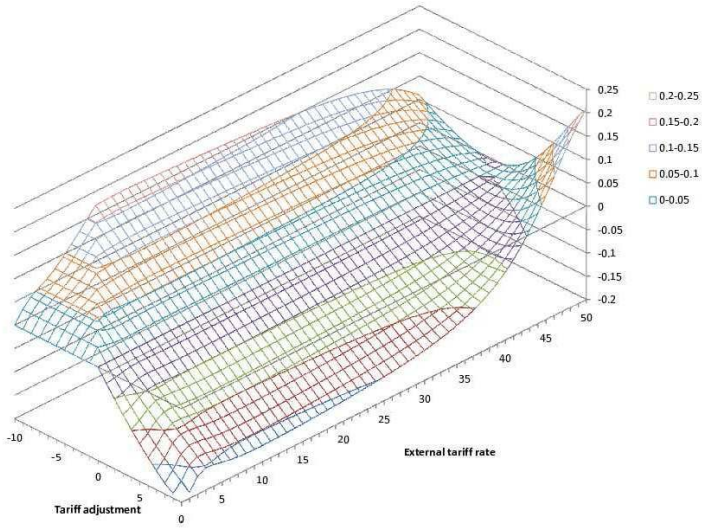

Figure 6.7 Tariffs reduction and capital income effect in CU countries

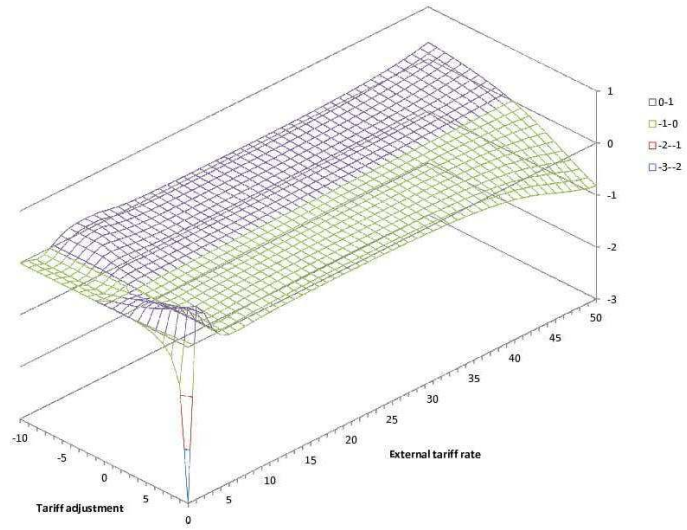

Figure 6.8 Tariffs reduction and government transfer effect in CU countries

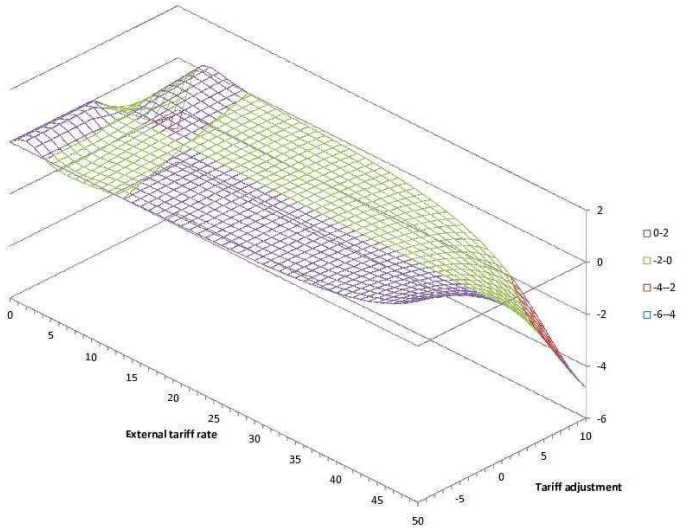

Figure 6.9 Tariffs reduction and consumer surplus effect in CU countries

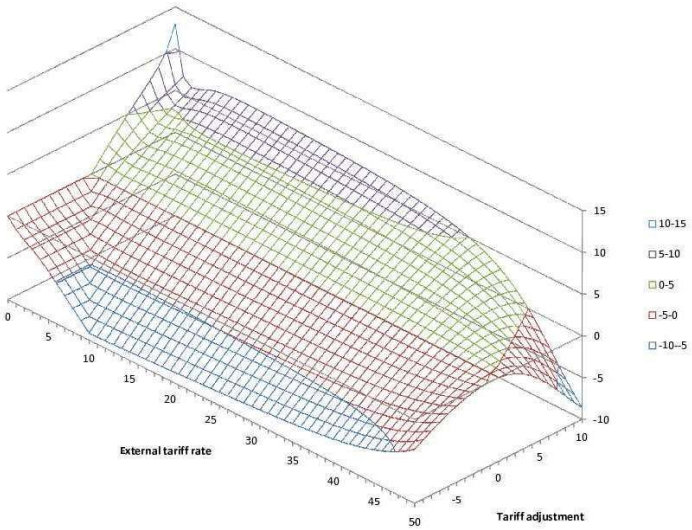

Figure 6.10 Tariffs reduction and government transfer effect in the ROW

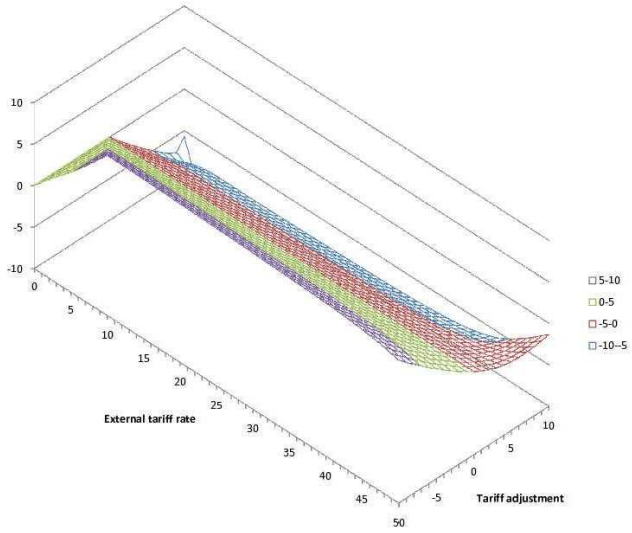

Figure 6.11 Tariffs reduction and consumer surplus effect in the ROW

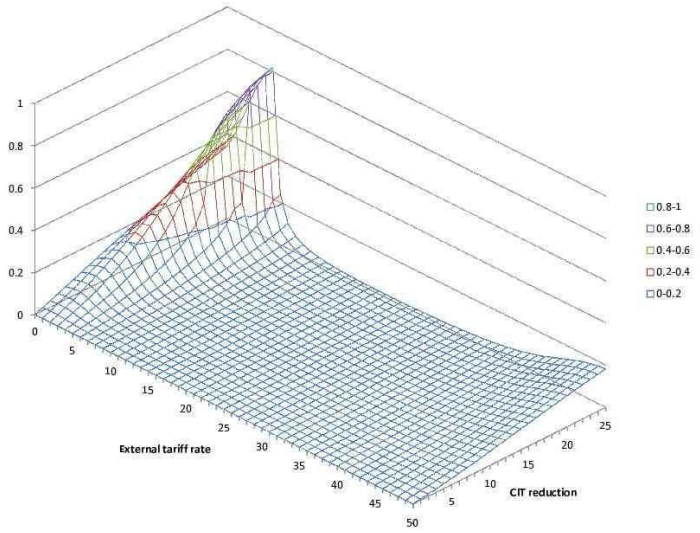

Figure 6.12 Stage 1: Change in the ratio of firms in the ROW

Change in the ratio of the number of firms in the ROW to the total number of firms in the world after the ROW reduces its CIT rate.

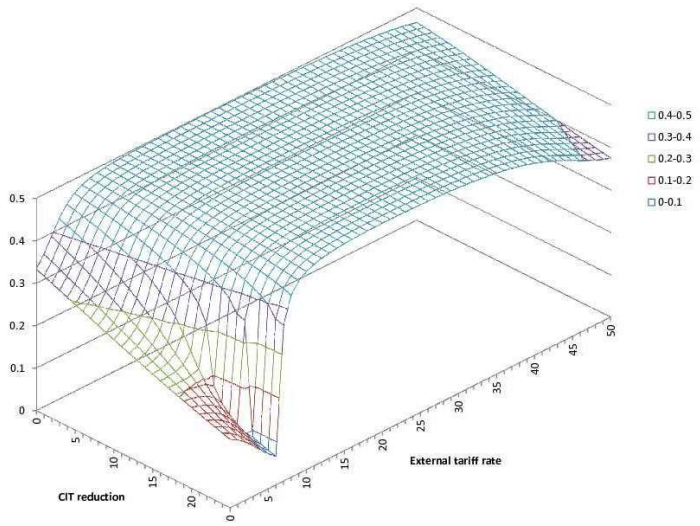

Figure 6.13 Stage 1: Share of firms in CU countries

Ratio of the number of firms in each CU country to the total number of firms in the world after the ROW reduces its CIT rate.

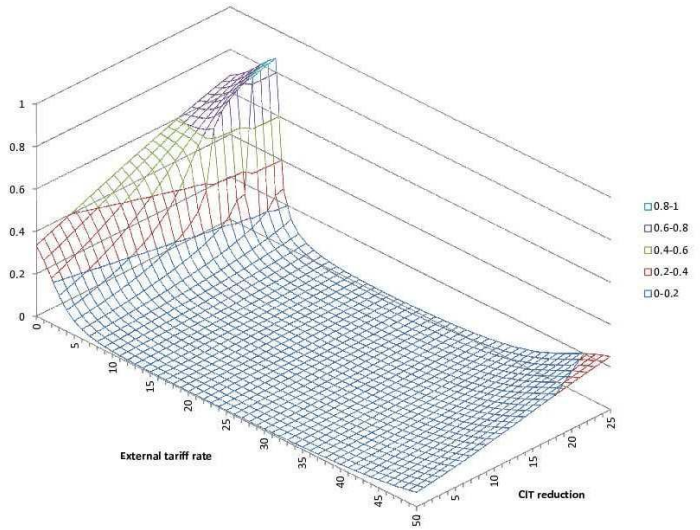

Figure 6.14 Stage 1: Share of firms in the ROW

Ratio of the number of firms in the ROW to the total number of firms in the world after the ROW reduces its CIT rate.

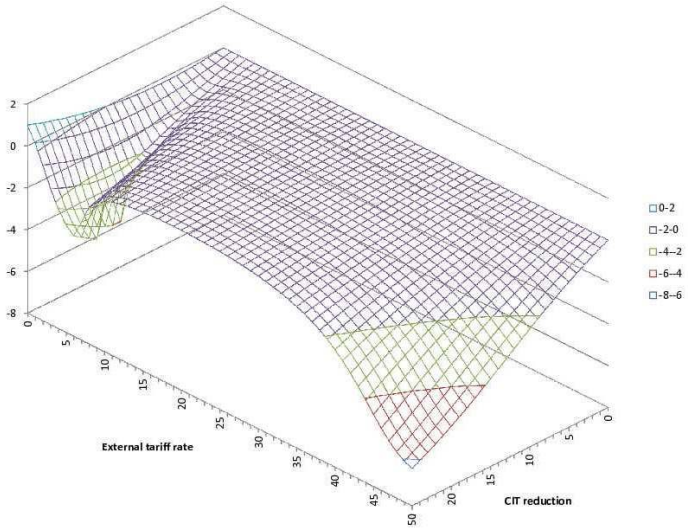

Figure 6.15 Stage 1: Total welfare change in CU countries

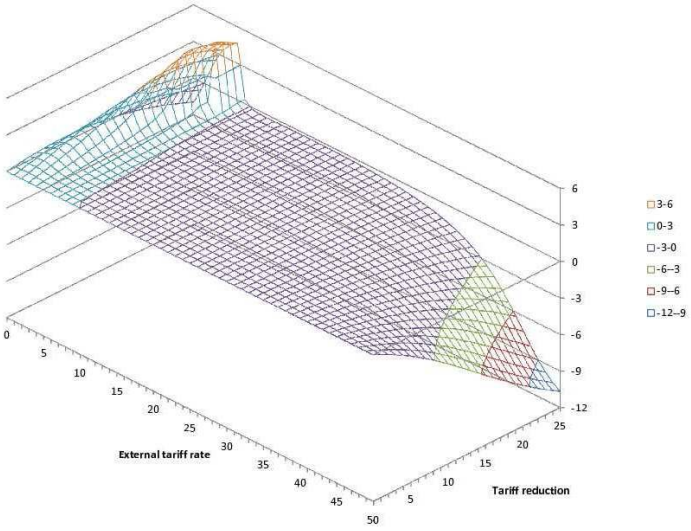

Figure 6.16 Stage 1: Total welfare change in the ROW

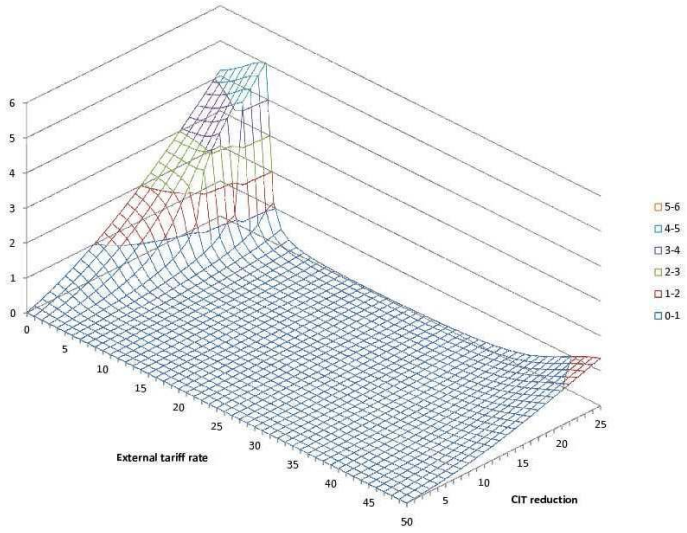

Figure 6.17 Stage 1: Capital income effect in CU countries

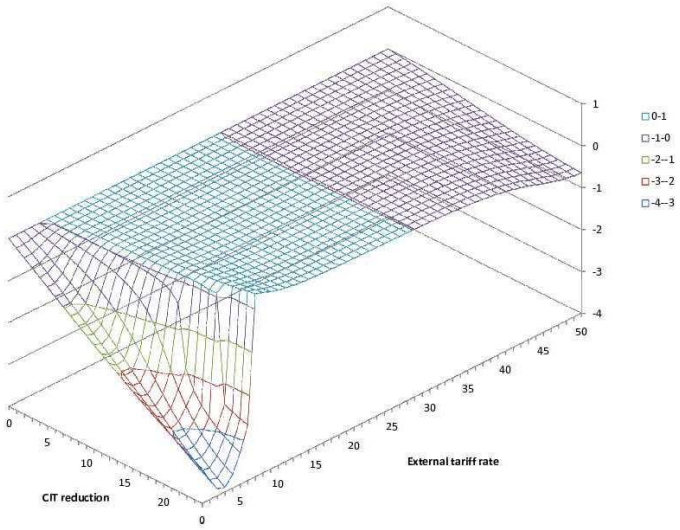

Figure 6.18 Stage 1: Government transfer effect CU countries

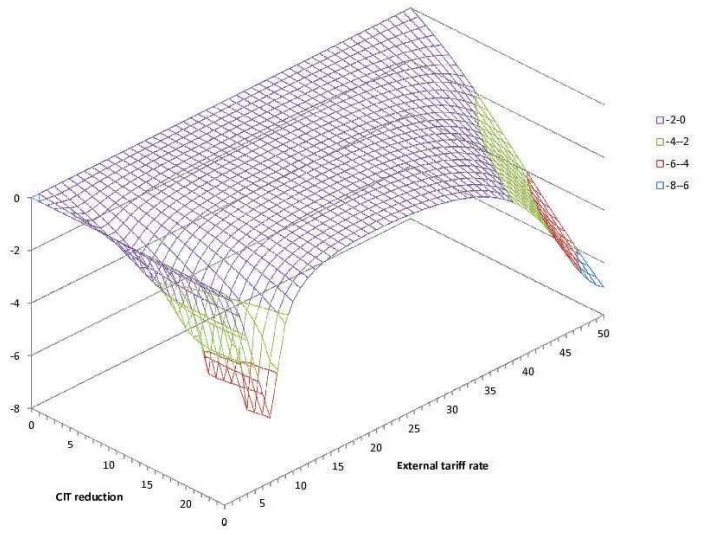

Figure 6.19 Stage 1: Consumer surplus effect CU countries

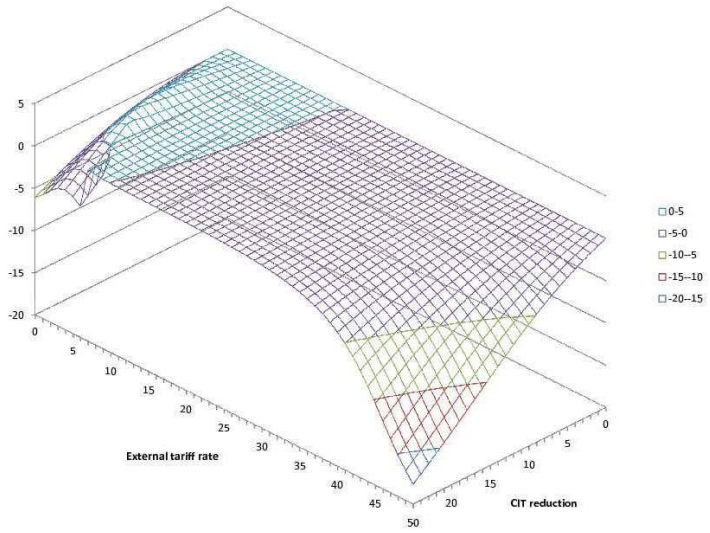

Figure 6.20 Stage 1: Government transfer effect in the ROW

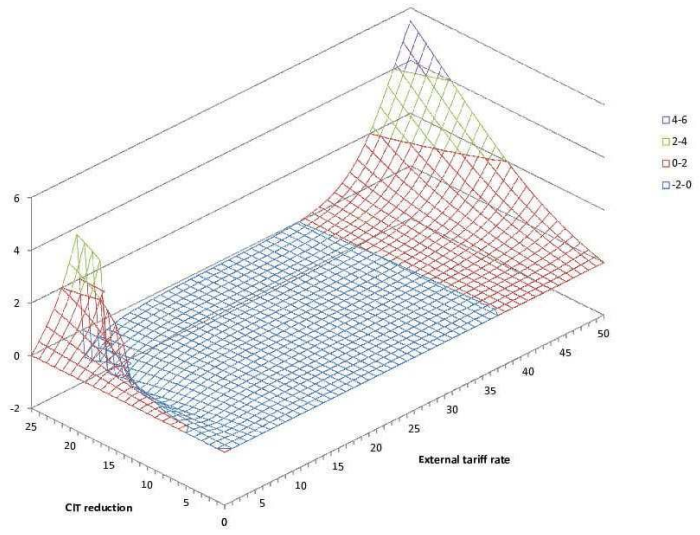

Figure 6.21 Stage 1: Consumer surplus effect in the ROW

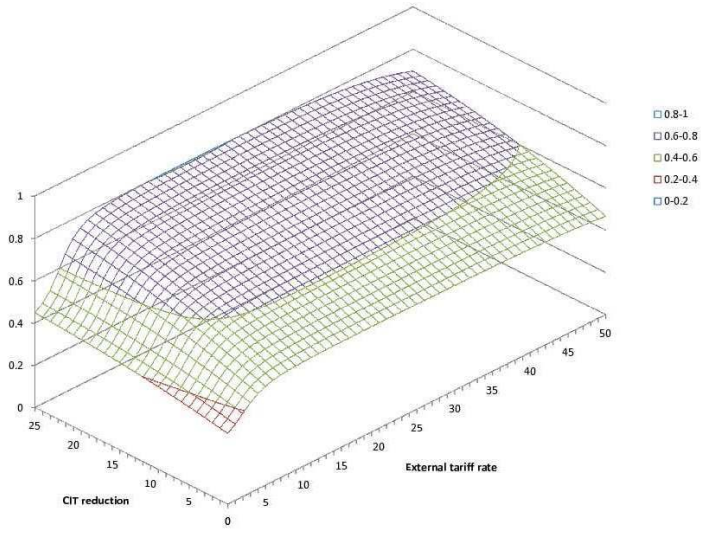

Figure 6.22 Stage 2: Share of firms in Country 1

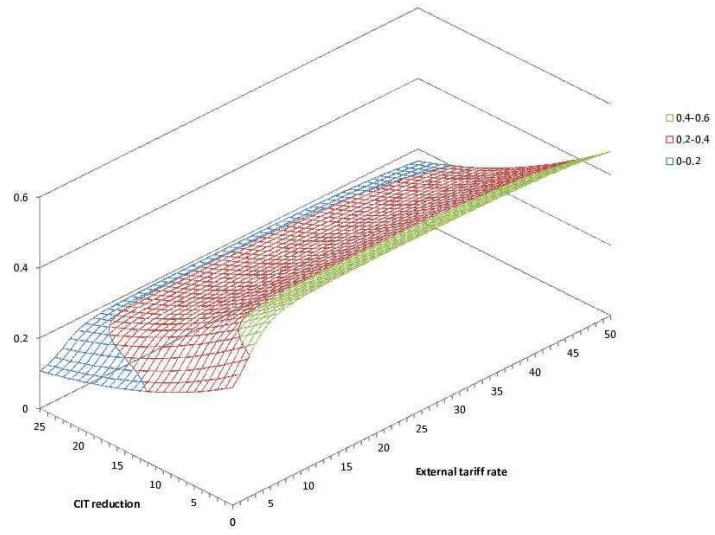

Figure 6.23 Stage 2: Share of firms in Country 2

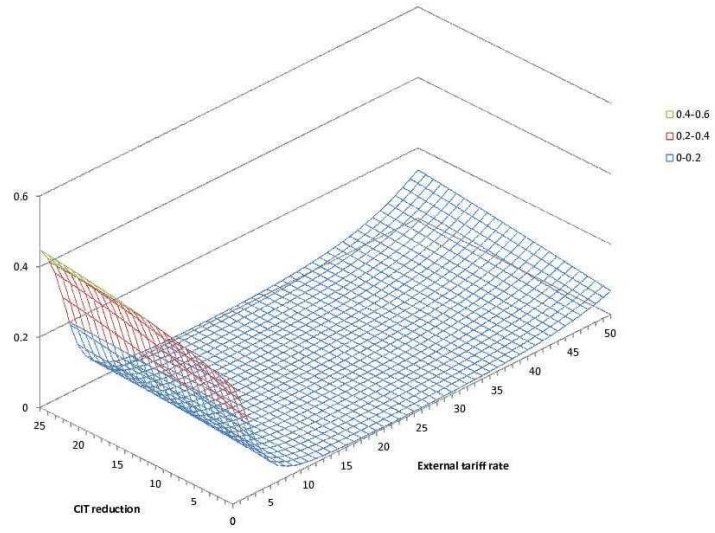

Figure 6.24 Stage 2: Share of firms in the ROW

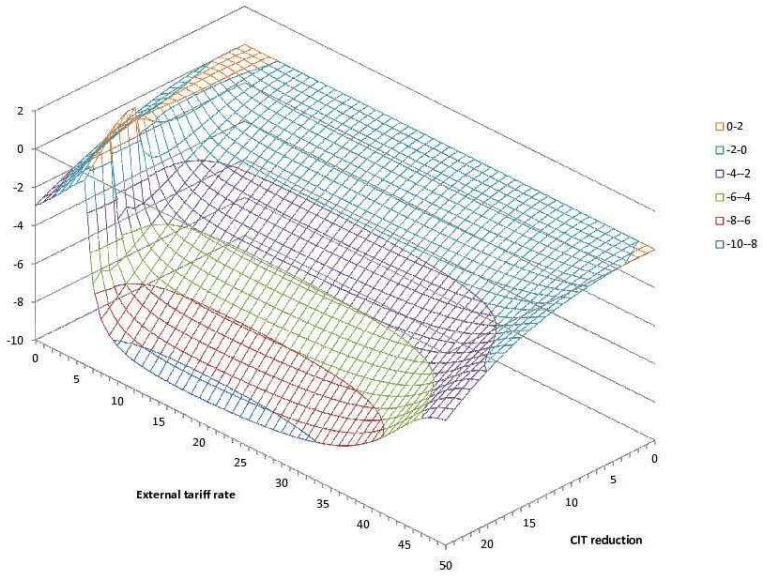

Figure 6.25 Stage 2: Total welfare change in Country 1

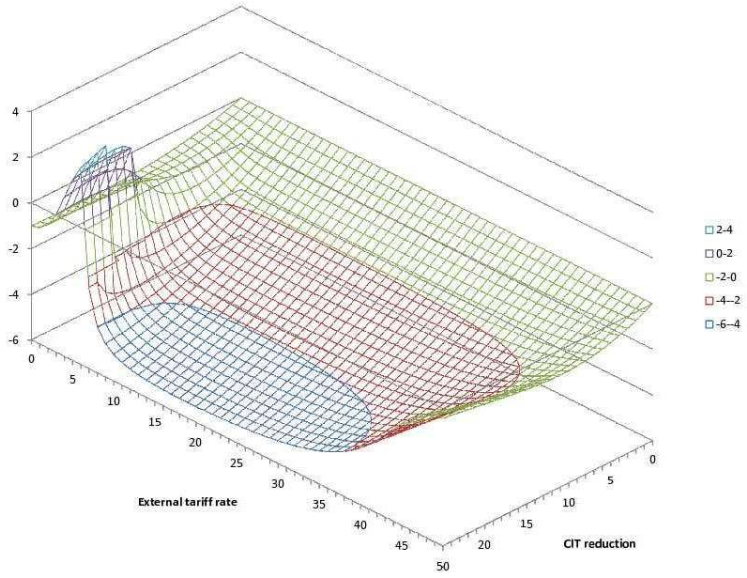

Figure 6.26 Stage 2: Total welfare change in Country 2

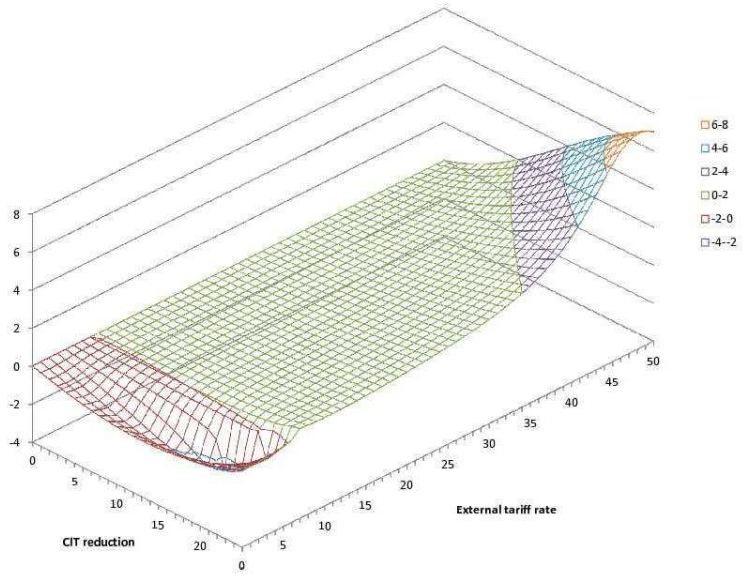

Figure 6.27 Stage 2: Total welfare change in the ROW

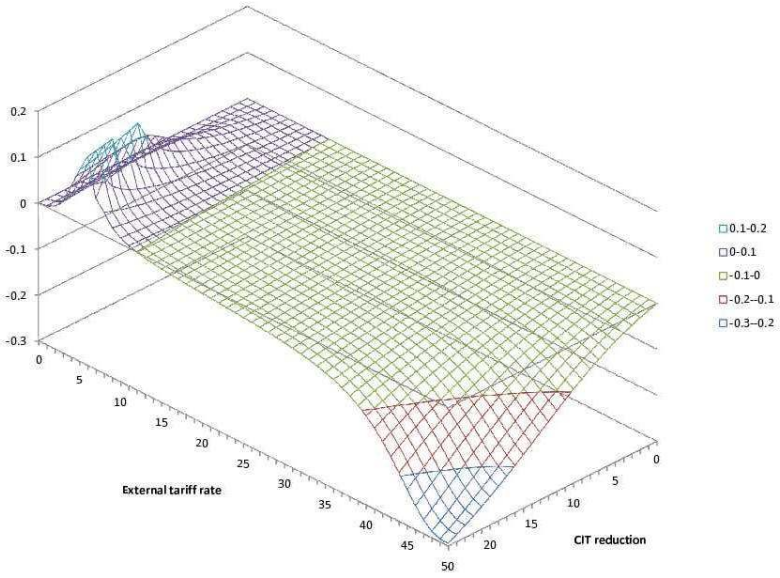

Figure 6.28 Stage 2: Capital income effect in Country 1

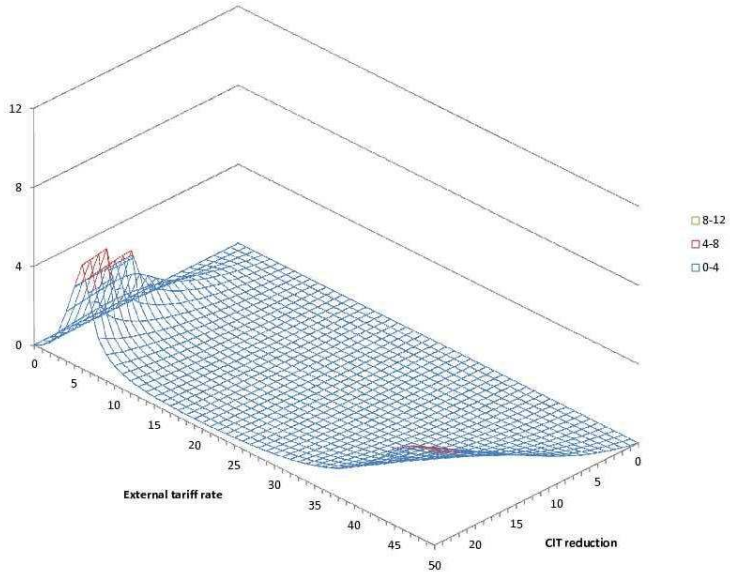

Figure 6.29 Stage 2: Consumer surplus effect in country 1

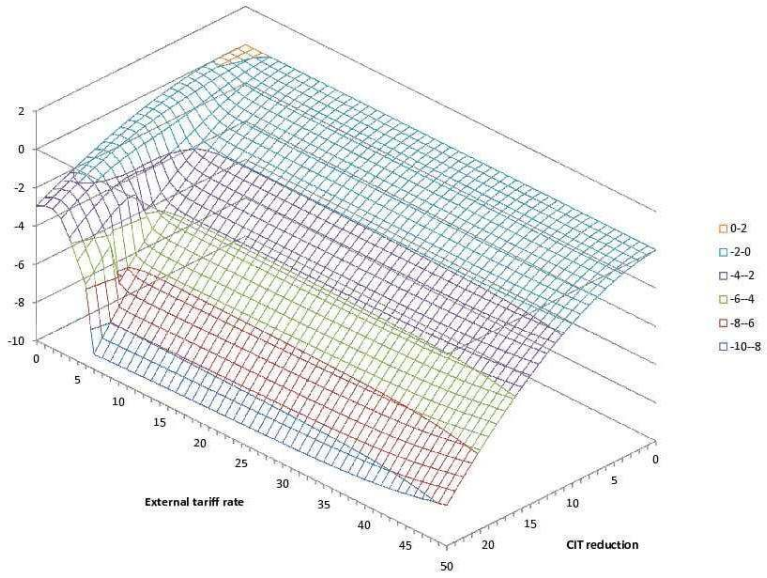

Figure 6.30 Stage 2: Government transfer effect in country 1

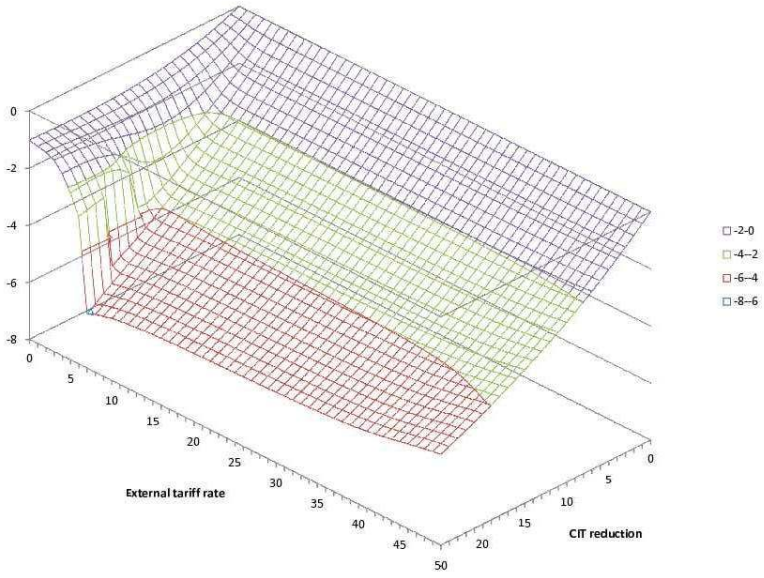

Figure 6.31 Stage 2: Government transfer effect in Country 2

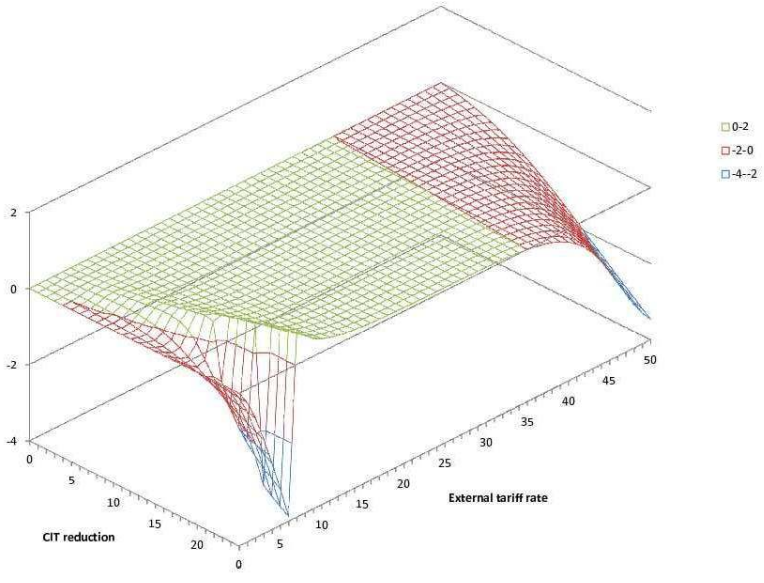

Figure 6.32 Stage 2: Consumer surplus effect in the ROW

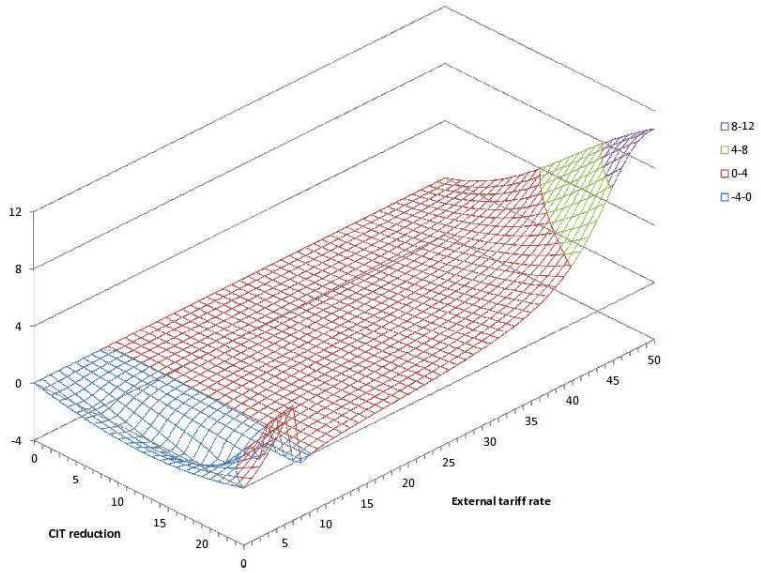

Figure 6.33 Stage 2: Government transfer effect in the ROW

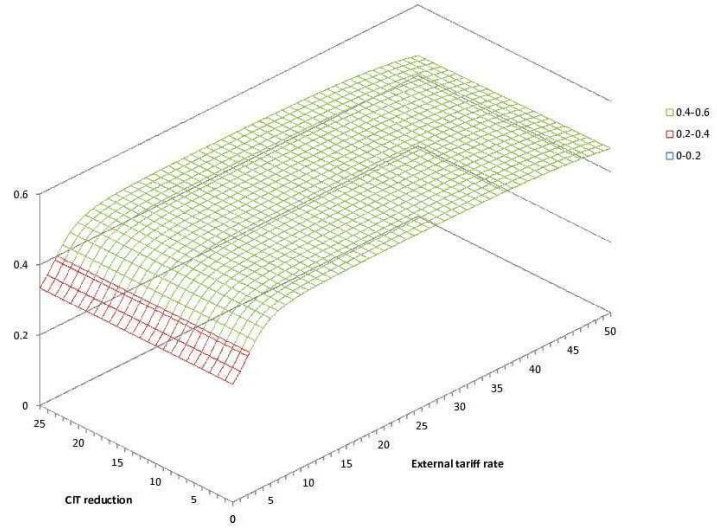

Figure 6.34 Stage 3: Share of firms in CU countries

Ratio of the number of firms in CU countries to the total number of firms in the world after Country 2 reduces its CIT rate to match those of Country 1 and the ROW.

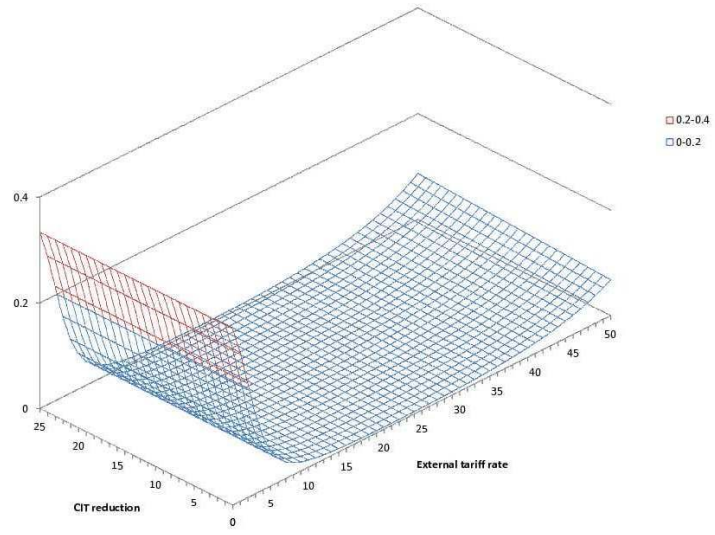

Figure 6.35 Stage 3: Share of firms in the ROW

Ratio of the number of firms in the ROW to the total number of firms in the world after Country 2 reduces its CIT rate to match those of Country 1 and the ROW.

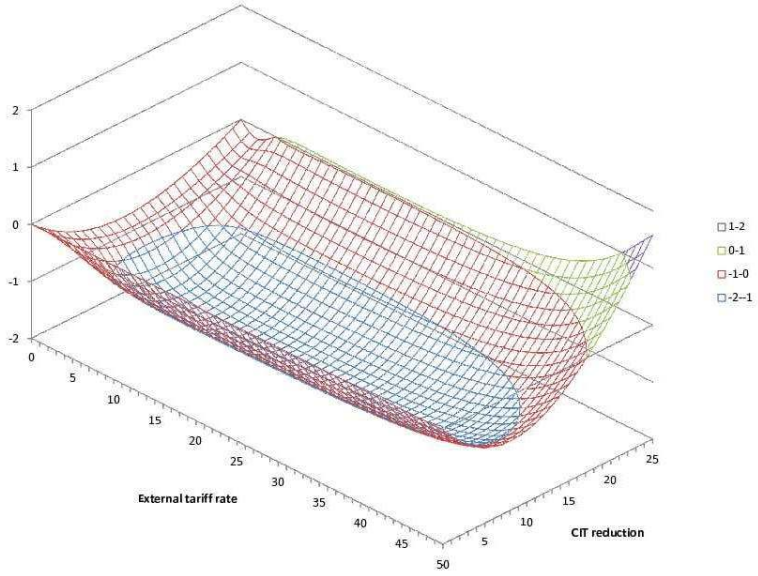

Figure 6.36 Stage 3: Total welfare change in Country 1

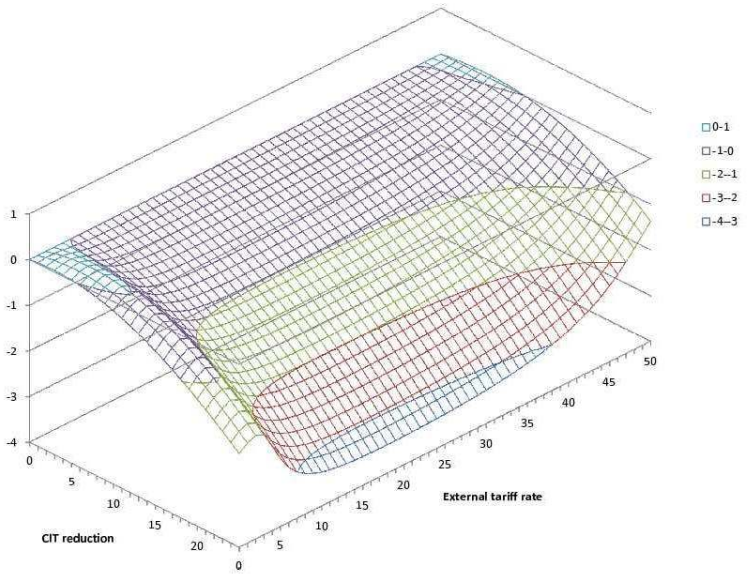

Figure 6.37 Stage 3: Total welfare change in Country 2

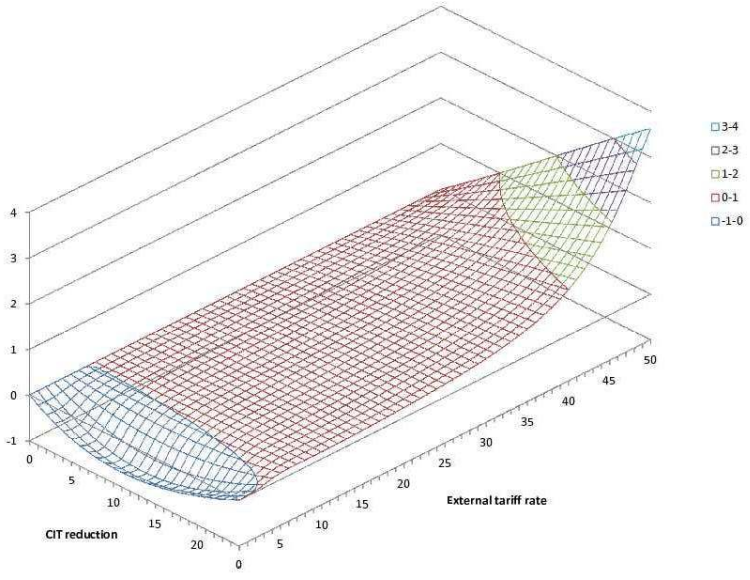

Figure 6.38 Stage 3: Total welfare change in the ROW

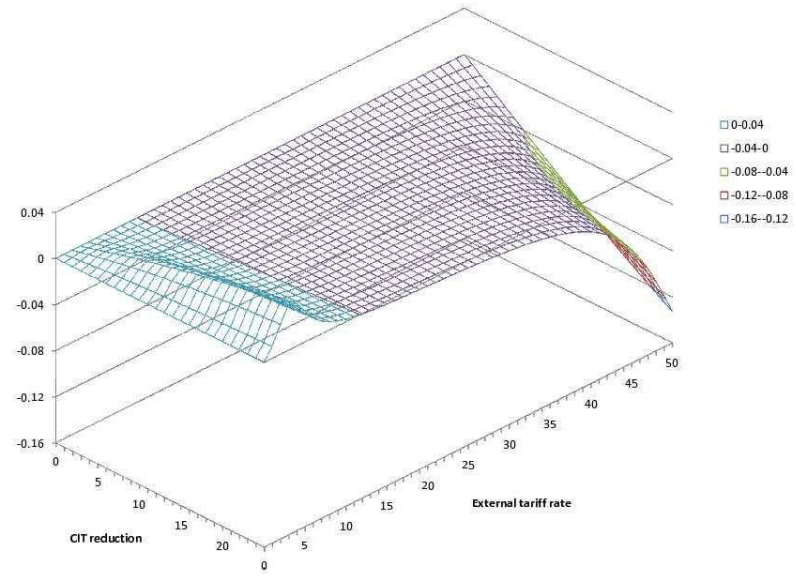

Figure 6.39 Stage 3: Capital income effect in Country 1

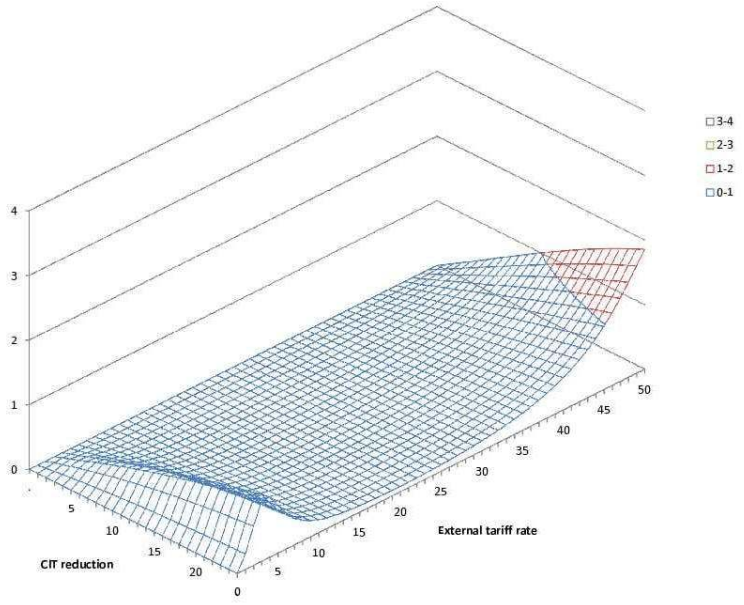

Figure 6.40 Stage 3: Consumer surplus effect in Country 1

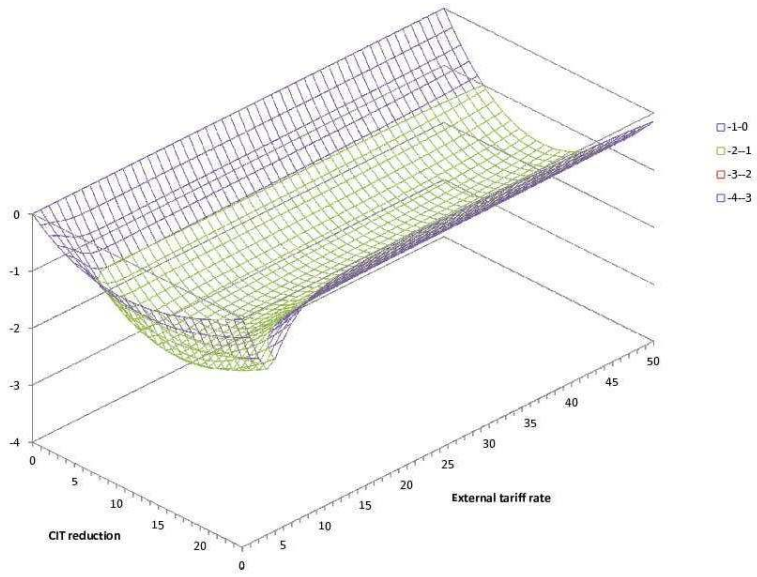

Figure 6.41 Stage 3: Government transfer effect in Country 1

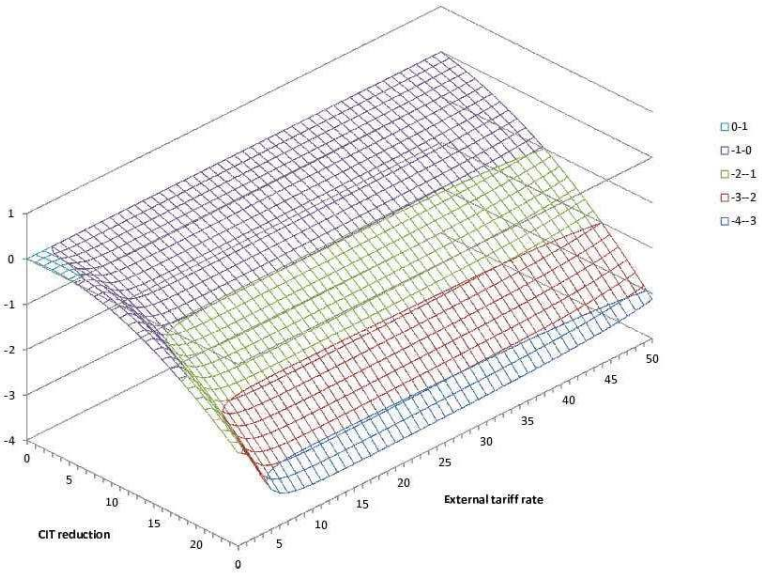

Figure 6.42 Stage 3: Government transfer effect in Country 2

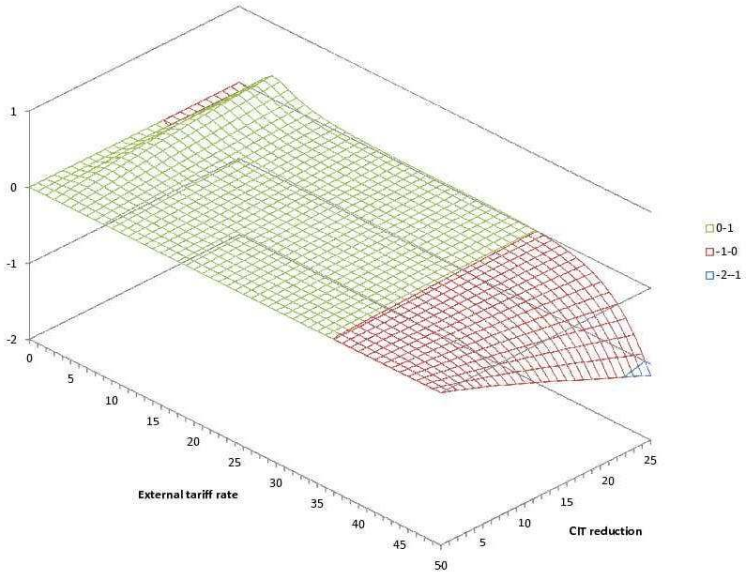

Figure 6.43 Stage 3: Consumer surplus effect in the ROW

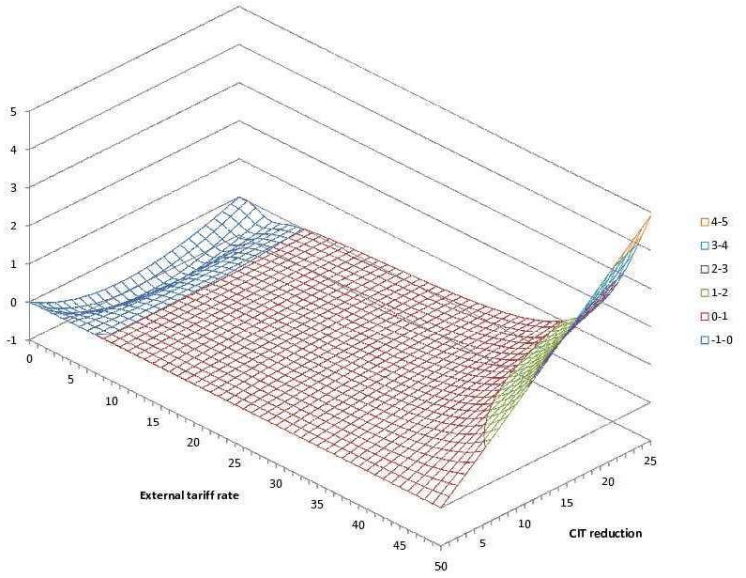

Figure 6.44 Stage 3: Government transfer effect in the ROW

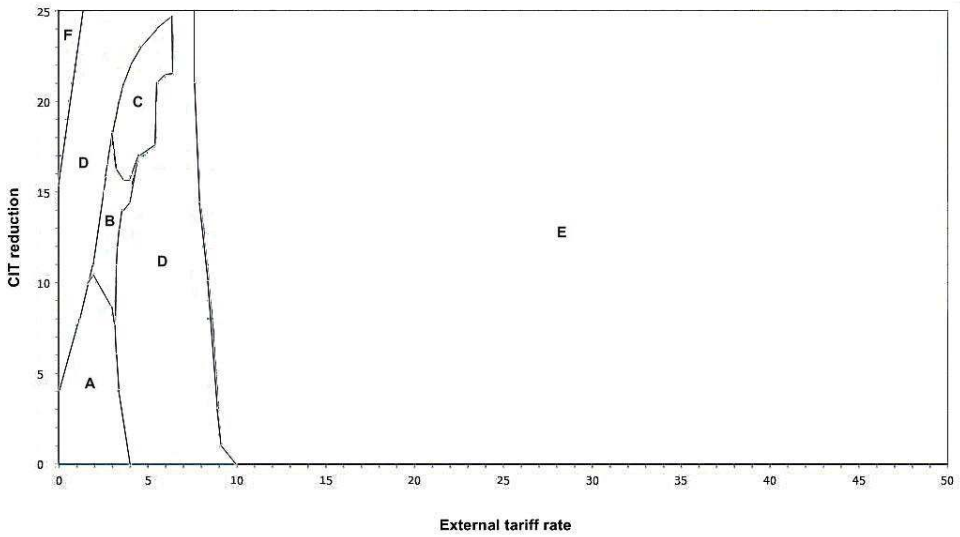

Figure 6.45 External tariff rate and intergovernmental tax competition

, where the initial CIT rate, t_r, is 25 percent.

Chapter 7

Conclusion

Preferential trade agreements are an important aspect of the world trading system. More than five hundred PTAs have been notified to the World Trade Organization (WTO). However, not all of them perform well: as pointed out by a recent WTO report, as of January 2013, 186 have been inactive[31]. One important reason for the proliferation of Preferential Trade Agreements is that policymakers perceive that their countries can better achieve their development and economic growth objectives and earn other benefits from signing up to such agreements. Evidence such as that documented by Baltagi, Egger and Pfaffermayr (2008), MacDermott (2007), Tekin-Koru and Waldkirch (2010) suggest that the formation of PTA can attract FDI into the countries in the bloc − frequently at the expense of the excluded countries. The potential of PTAs to affect the location choices of FDI convinces policy makers that they can attract new firms or prevent existing firms from leaving the country. If preferential trade agreements induce either their members or the excluded countries to opt for aggressive action – particularly by using taxation policies − then the formation of PTA may trigger intergovernmental tax competition. Evidence such as that documented by Altshuler and Goodspeed (2002), Devereux, Lockwood and Redoano (2008) and Overesch and Rincke (2011) suggest that the recent move by many countries intensifies global competition among governments. Thus there is raising concern among policymakers that it may have undesirable effects, which may be producing a continuous harmful increase in costly investment incentives that

[31]World Trade Organization (2013). "Evolution of Regional Trade Agreements in the world, 1948-2012" http://www.wto.org/english/tratop_e/region_e/regfac_e.htm.(accessed July 10, 2013).

deteriorate countries' public finances and create market distortion in the allocation of real investment.

Our aim in this thesis was to explore two issues, concerning:

iii) The effect of the formation of a Preferential Trade Agreement on the location of industry and welfare for both the member countries and the excluded countries.

iv) The effects and consequences of subsequent (i.e. post PTA formation) policies that may arise as a result of the adverse effects of the formation of Preferential Trade Agreement? In particular, we focused on the modification of import tariff and corporate income tax rates by governments – which may trigger international tax competition − in response to the loss of industry after the formation of a Preferential Trade Agreement.

Prior to this analysis, we needed to ascertain whether such strategic taxation policies' interactions among governments indeed occur. This was a necessary step because governments may also have other reasons to adjust their taxation policies rather than just engaging in tax competition with a view to attract and/or retain industry. Therefore, we conducted a preliminary empirical study using data for 21 EU countries from 2000 to 2009 to investigate whether a decline in the statutory rates of corporation tax in the EU is caused by strategic tax policy interactions among EU countries. We separated these countries into two groups. The first group joined the EU before 2000. The second group joined the EU in 2004. The instrumental variables and the two-stage estimation methods were used to investigate strategic tax policy interactions among EU countries.

We found evidence of the fact that European countries' governments used statutory corporate income tax rates to compete against other countries. At the individual country level, different countries may use different tax measures to compete over attracting investment. Thus, whilst high PITR countries may use effective marginal tax rates, lower personal income tax rates countries may use statutory corporate income tax rates to compete over attracting investment. These results are also consistent with, and complement, the previous relevant literature. We also found that governments may use statutory corporate income tax rates rather than effective marginal tax rates − as a backstop to the reclassification of labour income as business income. Finally, we did not find any evidence pointing to the effects of the group of 6 countries that joined the EU in 2004 to be significantly different from the group of 15 member countries that joined the EU before 2000. Therefore, we concluded that the enlargement of EU did not intensify tax competition among EU countries.

Our results in chapter 5 and 6 provide a theoretical rationale for two key questions we posed at the beginning of this thesis. Using a computational general equilibrium model with three-country, two sectors and two primary factors, we examined the effects arising from the formation of a PTA to the international movement of firms in the manufacturing sector. The manufacturing sector was modeled as being monopolistically competitive, with firms producing a variety of imperfect substitutes under increasing returns to scale. One of the distinctive features of our framework is that it explicitly models firm-to-firm sales in an input-output fashion, thus capturing the vertical fragmentation of production into the model. Furthermore, whilst NEG models generally use an ad hoc capital allocation mechanism, we introduced a capital allocation mechanism underpinned by an

assumption of imperfect substitutability between the capital stocks from different countries. As a result, an investor may prefer to invest in a particular country rather than in others. Four main results emerged from our analysis, which contribute to the existing economic literature.

First, we found that the eradication of intra-tariff between PTA member countries always attracts investments from the excluded country. Specifically, the formation of a PTA can possibly yield three different outcomes in terms of welfare, depending on the member countries' characteristics as well as the existing external tariffs level, i.e:

1) **All countries are better off.** A formation of a PTA between symmetric countries makes all member countries as well as the excluded country better off. We also find a similar result when the country sizes are slightly different. Additionally, a country with the high cost of production may be able to retain a small fraction of firms when it forms a PTA with a low cost country, whilst almost all of the firms disappear from the excluded country. Not only does this type of PTA formation make the PTA member countries better off – including the one with the high cost of production – but it can also generate a welfare gain in the excluded country, even when it loses all of its manufacturing sector.

2) **Only member countries are better off.** A PTA formation between small countries that leave the most sizeable country out of the agreement generates welfare gains to the member countries, except when the external tariffs are high. In this case, the excluded country would be made worse off by the PTA formation regardless of the level of external tariffs.

3) **All countries are worse off.** A PTA formation between low productivity countries that leaves a high productivity country out of the agreement makes both member countries and the excluded country worse off. Despite this, this type of formation is a trade creating PTA, when the external tariffs are at low, intermediate and high level, but it is a trade diverting PTA, when the external tariffs are at prohibitive high level.

Second, we show that an increase in the external tariff rate by the excluded country is not an effective policy to retain investments, if firms already have agglomerated in a CU area. This is because the number of relocating firms is relatively negligible, when the ROW's government increases its tariff. Additionally, the ROW's consumers may suffer from welfare loss. On the other hand, a unilateral decrease in tariff by the ROW is generally Pareto improving in the sense that consumers in both the ROW and CU area benefit from welfare gain – even if the ROW loses some of its remaining firms to CU countries.

Third, the excluded country's government has no incentive to reduce its corporate income tax rate, if the external tariffs are sufficiently high – as doing so would make its consumers suffer from welfare losses. However the reduction of corporate income tax may become an efficient instrument for the excluded country's government to retain investments, if the external tariffs are sufficiently low.

Fourth, the reduction of the excluded country's corporate income tax rate − at sufficiently low level of external tariffs – generates welfare gains for the excluded country's consumers. Additionally, three possible response scenarios from CU countries may arise. The first one is that all member countries choose not to engage in intergovernmental tax competition. The second one is that all member countries engage in intergovernmental tax competition. The last one is that only one of the

member countries engage in tax competition with the excluded country, while the other member keeps imposing its status quo corporate income tax rate.

Regarding policy implications, this thesis can potentially offer compelling insights that are useful towards policy deliberations. A government can achieve its aim to attract investment into the country and improve consumers' welfare via a creation of PTAs with other trading partners. The characteristics of the partner country, however, do appear to matter. In particular, a key implication of our results is that developing countries should aim to form PTAs with countries characterised by higher levels of development instead of pursuing agreements that only encompass countries at a similar level of industrialisation. Additionally, our results suggests that all members of a PTA should eradicate all barriers of intra-trade to prevent an occurrence of an internal catastrophic or a two-tier home-market effect – in which all firms agglomerate in the country with the largest market and/or with the lowest costs of production.

Given that the excluded countries always lose some investments to CU member countries, a government may have an incentive to implement measured aimed at retaining investments in the country and/or at improving consumers' welfare. Our results suggest that, to these ends, the excluded country may have several alternative policy options,[32] i.e.:

1) The first alternative is for the excluded country to join the PTA. This is probably the best scenario that may lead to the first best outcome, in which all countries join the same PTA and eventually international trade is perfectly free.

[32] Given the relative simplicity of our framework, not all of these implications stem directly from our analysis.

2) If the excluded country cannot join the PTA immediately, the second alternative is to improve firms' competitiveness. This can be done by improving firms' total factor productivity or increasing the level of vertical linkages. To this end, the government may use subsidy/tax policies that encourage firms to adopt more advanced technologies in their production processes, resulting in higher factor productivity. Additionally, governments may also need to invest in education to increase the supply of high skill labour capable of utilizing an advanced technology. More generally, given that empirically the degree of *roundaboutness* of the production process – i.e. the extent of specialization and strength of vertical linkages – depends on the level of economic development,[33] any policies that foster economic growth will typically result in stronger vertical linkages, with a greater reliance of firms on products produced by other firms rather than on in-house production of intermediate inputs. As our theoretical results suggest, policies that increase firms' factor productivity or the level of vertical linkages will attract investments into the country. Furthermore, these policies may lead to a loss of welfare in the PTA member countries – which may in turn results in PTA countries having an incentive to offer high productivity (and/or vertical linkages) excluded countries to join the PTA.

3) As a third alternative, the excluded country may adjust its tariff rates. as the third alternated policy. Even though this policy tool is not effective to retain investments in the country, by lowering its tariff rates when firms have

[33] For empirical evidence on inter-industry connections leading to external returns to scale in manufacturing see, e.g. Caballero and Lyons (1992) and Bartelsman, Caballero and Lyons (1994). At a theoretical level, the importance of vertical linkages as a major source of economy-wide increasing returns to scale has been widely acknowledged. See among others: Ethier (1982), Matsuyama (1995), Okuno-Fujiwara (1988), Rodriguez-Clare (1996), Rodrik (1996), Venables (1996b), Molana and Montagna (2006, 2007b, 2007a).

already agglomerated in the PTA area, the excluded country's government may be able to improve its consumers' welfare.

4) The final policy option is the reduction of CIT. The excluded country may be able to retain investments by reducing its CIT, if the external tariffs are low. However, the reduction of CIT in the excluded country may trigger inter-governmental tax competition that lead to a further relocation of investments. Nevertheless, the excluded country should not reduce its CIT, if the external tariffs are sufficiently high. The reduction of CIT by the excluded country – at these level of tariffs − may also make the ROW's consumers suffer from a welfare loss.

The key implication of the last point is that PTAs member countries may be able to impose a higher corporate income tax rate than that of the excluded country, as long as those rates are not too much higher. The excluded country may instead choose its corporate income tax rate unconstrained from an attempt to attract investments, which is similar to the scenario that is suggested by Baldwin and Krugman (2004).

Finally, governments of PTA member countries do not necessarily engage in intergovernmental tax competition over foreign investment as doing so would harm consumer welfare. However, engaging in tax competition may still be welfare improving, depending on the level of external tariffs and the extent of corporate income tax reduction from the excluded country.

It is worth noting that our results are obtained by means of numerical simulation. Although great care was taken to check the robustness of our results to the plausible parameter ranges, this methodology inevitably limits the generality of our conclusions.

The theoretical framework developed in the thesis also presents several other limitations. First, our results are based on the assumptions that the level of vertical linkages is sufficiently high and the only trade barriers are in the form of import tariffs. Second, labour and firms are assumed to be homogeneous. These aspects need to be taken into account before making any strong policy recommendations based on the implications of this analysis. In addition, we do not consider rules of origin, which is a distinct feature of FTA used to prevent a re-route import.

The work presented in this thesis offers several potential possibilities for further study. We list a few here for future consideration.

Even though the results from preliminary empirical study in Chapter 2 would be sufficient to conclude that there is some degree of tax competitions among European countries over the period considered, it should be noted that given the problems identified with some of the diagnostic test statistics, we may need to use other econometric methodologies in order to verify the robustness of our results. Another possible extension is to use another measure of corporate income tax rates, i.e. EATR, as the main variable in the analysis. This may yield more robustness to the results as this measure is argued to be more relevant to the decision of firm location.

Then two immediate extensions to the theoretical part of this thesis are worth considering for future study. The first would entail adding trade costs into the existing model. Iceberg trade costs, which are typically used in New Economic Geography models, are an obvious choice. Incorporating iceberg trade costs as additional cost on cross-border trade in manufacturing good will undoubtedly yield valuable insights. The second extension that we can easily adapt our model to study is the use of government industrial subsidy provision. In the context of our model set

up, subsidy can be on either fixed cost or labour cost. This would enable us to study several issues such as, for example, the effect of industrial subsidy competition on the location of industry as well as the effect on the allocation of labour supply in each sector.

Another interesting potential extension would be to assume that each government independently chooses its tax policies to maximize the welfare of residents within the region. This change would allow us to investigate optimal taxation issues. Instead of assuming that governments directly transfer its revenue to its residents, we could also assume that they spend their revenue to produce public goods, which can be either consumed by residents or used as factor inputs by manufacturing firms. These changes of assumptions will undoubtedly yield valuable insights to the key questions we asked at the beginning of this thesis.

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